Learning law

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Expertise differences and the effect of instructional support

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Expertise differences and the effect of instructional support

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Voorwoord

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Fleurie Nievelstein
Kerkrade, 2009

Contents

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General introduction

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"Anthony, a 46-year old Dutchman, told his 32-year old Dutch fiancée Beatrice the day before their wedding that, in the past, he was married to another woman in the United States. After a few years they decided not to live together anymore, but the marriage has never been officially dissolved. Despite this statement, Beatrice married Anthony. Their marriage was performed in Amsterdam and two children were born. After three years of marriage, Anthony wants to end the marriage." *"Can Anthony apply for dissolution of the marriage? If the marriage can be dissoluted, what is the children's status? What happens with the acquired goods, supposed that there were no marriage conditions?"*

This case is an example of a true to life case of the kind often used in both Civil law (European-Continental) and Common law (Anglo-Saxon) education. Students need to find 'objectively correct' answers to the questions by considering different legal aspects and exploring every conceivable (counter) argument. Teaching students to solve such cases, is the main goal of legal education (Blasi, 1995; Vranken, 2006; Williams, 1992). Students are mainly taught to reason about cases through 'learning by doing'; that is, they are believed to learn to solve legal cases best by engaging in solving many cases (Marchant, Robinson, Anderson, & Schadewald, 1993; Williams, 1992). This instructional approach ('learning by doing') is embedded in different educational formats, such as formal lectures, tutorials, moot or trial courts, self-study assignments, electronic case-solving programmes, or collaborative learning assignments. These educational formats appear in almost all law schools to some extent, but the preferred or dominant educational format tends to differ somewhat between law schools in the Civil and Common law systems as well as between law schools within one system (Teich, 1986).

In both legal systems, problems have been noted regarding the quality of law students' reasoning (Sullivan, Colby, Welch-Wegner, Bond, & Shulman, 2007; Vranken, 2006). These problems seem to arise from the complexity of the domain, the way in which knowledge is acquired in complex domains, and the instructional approach of 'learning by doing' widely used in law schools.

Common and civil law

The Common law and the Civil law systems differ in several respects regarding reasoning about cases. In the Common law (Anglo-Saxon) system, legal professionals such as solicitors, judges, public prosecutors, and legal advisors solve cases mainly by drawing analogies to past cases and court judgments, and rely to a lesser extent on documented laws and doctrines (Ashley & Aleven, 1991; Dop, 2003). This type of reasoning is called *case-based reasoning* (Vandevelde, 1996). It is a cyclic and integrated process of solving problems, learning from this experience, and solving similar problems by analogy (Aamodt & Plaza, 1994). In this system, the rule of *stare decisis* binds lower courts to base their judgments by analogy on decisions made by the highest courts of law (Marchant et al.,1993; Vranken, 2006). Legislation will only be used to complete and/or to correct the Common law but will not precede it (Dop,

2003). To pose convincing and powerful arguments on new cases, lawyers need to compare them with precedents that have similar relevant features and resulted in court judgments that would also be favourable for their client, and emphasize differences with precedents that might seem similar but resulted in unfavourable court judgments (Vandevelde, 1996). The underlying legal framework that should be inferred from the similarities and dissimilarities between cases may at first glance seem simple but can grow increasingly complex due to contextual characteristics (Marchant et al., 1993; Vranken 2006) and the differing interests of the different parties involved (Stratman, 2002).

In the Continental (Civil law) system, jurisdiction is based more on the application of codified rules and doctrines than on comparisons with prior cases (Dop, 2003). Legal problems are analyzed in light of generally accepted rules from which a solution can be deduced (Stratman, 2004), and this type of reasoning can therefore be called *rule-based reasoning* (Vandevelde, 1996). Codification in Civil law goes back thousands of years when most rules were abstracted from judicial decisions of concrete cases (Vranken, 2006). Making use of codification in reasoning about cases guarantees the predictability and unity of jurisdiction (Dop, 2003). However, when codes or statutes cannot give an unambiguous answer or when new cases contain similar relevant features as previous cases that had strong favourable court judgments, judges may base their decision on past court judgments (Vandevelde, 1996). Furthermore, the interpretation of codes and statutes can change depending on the changing views on rationality and righteousness (e.g., twenty years ago, someone would be prosecuted for making a certain statement in public, whereas nowadays, this would not be the case, or vice versa).

Despite those differences, reasoning about cases is one of the core activities for professionals in both the Common and Civil law systems (Lundeberg, 1987; Stratman, 2002), and therefore, it is also a core activity for law students in preparation for legal practice.

Law education

As a result of the differences between case-based and rule-based reasoning, educational formats differ somewhat between the law systems. For example, in Common law, the Socratic case-dialogue method is the most applied format (Sullivan, et al., 2007; Teich, 1986). Other formats such as formal lectures, tutorials, moot or trial courts (i.e., the adversary method), self-study assignments, electronic case-solving programmes, collaborative learning assignments, and the problem method in which students have to read cases, texts of law, and other law-related resources in preparation to answer problems of standard law school examinations, are also used in Common law, but to a lesser extent than in Civil law (Sullivan, et al., 2007; Teich, 1986). Although most Civil law schools use many of those techniques at least once in the curriculum, they usually have a certain preferred or dominant technique (e.g., some have more emphasis on lectures, some on self-study, some on collaborative

learning). As mentioned before, regardless of the educational format used in law schools, learning to reason about cases relies predominantly on doing just that (i.e., 'learning by doing') and as a result students usually have to reason about lots and lots of cases using the information sources that professionals also have available (Blasi, 1995; Sullivan et al., 2007; Vandevelde, 1996; Vranken, 2006).

Several authors have pointed out some general problems with legal education, noting that graduates often experience difficulties when they enter the profession, as a result of fragmentation of knowledge necessary to reason about cases (Sullivan et al., 2007; Vranken, 2006)[1]. When students enter the profession by apprenticeship, for example, their academic knowledge does not completely correspond with the necessary professional knowledge. Sullivan et al. and Vranken state that students are educated to compare and contrast cases and/or to apply rules and principles to legal problems in a systematic way, time and time again, but without enough focus on *integrating* different kinds of knowledge (e.g., knowledge of previous court judgments, laws, ethical aspects, political aspects, religious aspects, changes in society, et cetera). Without such integration, transfer of acquired reasoning skills to real-world cases that require a different approach, will be hampered.

However, it is not just when transitioning from law school to the profession that problems with reasoning skills become apparent. Also in the acquisition of this complex skill students seem to experience serious difficulties. From an interview study we conducted with Dutch law students and law faculty members specialized in private law, a picture emerges of the most important problems and causes. We asked 24 first-year (novice) students and 24 third-year (advanced) students to tell us whether they experienced difficulties with learning to reason about cases and if so, to elaborate on those. In addition, we asked 12 law faculty members to elaborate on the kind of difficulties they think their students experience when learning to reason about cases. The results were as follows: 87% of the first-year students indicated to experience difficulties due to the fact that they do not understand the exact meaning of concepts related to a case, 30% indicated to experience difficulties with using external information sources such as codes, 22% mentioned that it is difficult to take into account the different perspectives that can be taken on a case, and 13% said that it is difficult to make connections between different aspects of a case. Remarkably, the third-year students mentioned similar difficulties, along with some additional problems: 94% indicated to experience difficulties because they do not understand the exact meaning of concepts related to a case, 89% said to experience difficulties with using external sources, 61% mentioned that it is difficult to draw connections between different aspects of a case. Furthermore, 28% mentioned that they lack the necessary legal knowledge to understand the judicial implication of the case, and 11% mentioned that they have difficulties with interpreting court judgments and exceptions on rules. It is quite striking that the problems experienced seem to in-

[1] Law education is not unique in this respect; for a general discussion of the problems of fragmentation in education, see Van Merriënboer and Kirschner (2007) and for a discussion of the problems that the transition from school to work can bring along in a variety of domains, see Boshuizen, Bromme, and Gruber (2004).

crease rather than decrease when students progress through law school. The faculty members' responses were in almost complete agreement with the students' answers. They unanimously mentioned that, in their experience, students have difficulties with learning to reason about cases because they do not understand the correct formal meaning of concepts, have problems with understanding information from external sources, and with taking different legal perspectives on a case.

Characteristics of the legal domain that make learning law difficult

Conceptual knowledge and ontology

The first requirement to be able to understand and reason about cases is a correct understanding of legal concepts (Sullivan et al., 2007). Conceptual knowledge is necessary to abstract the relevant legal information from contextualized problems and from external sources (Lundeberg, 1987; Sullivan et al., 2007). Students, especially novices, lack knowledge of the formal legal language (Blasi, 1995; Deegan, 1995; Lindahl, 2004). Acquiring correct conceptual knowledge is, however, very difficult for two reasons. A first difficulty is that learning the 'official' legal language requires conceptual restructuring since many concepts that are routinely used in everyday language often have a specific formal meaning in law (Deegan, 1995; Lindahl, 2004; Lundeberg, 1987; Stratman, 2002; for a description of similar problems in the domain of science, see e.g., Chi, 2005; Chi & Roscoe, 2002). The moment students enter law school, their naïve conceptual knowledge should first be replaced by the formal, judicial meaning of the same concepts. A second difficulty is that various concepts (called intermediate concepts; Ashley & Aleven, 1991; Lindahl, 2003, 2004) do not have one single, fixed meaning; instead, the function of these concepts varies depending on the context (Ashley & Aleven, 1991; Lindahl, 2003, 2004; Vervoordeldonk, 2006; Vranken 2006). The concept *written agreement*, for example, can refer to the tangible object itself (i.e., a paper contract) or it can refer to the specified agreed upon rights and duties. In this example, the context is important to interpret the meaning of the concept literally. In the following example on *ownership*, the context is important to understand the structural meaning of the concept, and the legal implications of the concept may change drastically depending on context. *Ownership* has different implications in terms of rights and duties depending on the kind of object that is owned. For instance, ownership with regard to pets implies other rights and duties than ownership with regard to immovable property. As these examples show, the exact implications of intermediate concepts can only be understood in the light of contextual circumstances (Ashley & Aleven, 1991; Lindahl, 2003; Vranken, 2006).

Related to the acquisition of correct conceptual knowledge, is the need to learn the domain's *ontology*. The term ontology in its philosophical definition, refers to the conceptual knowledge regarding basic categories of existence in life such as plants, animals and objects, and implies knowledge about the features and underlying

principles of those basic categories (see e.g., Kelly & Keil, 1985). Nowadays, the term ontology is often used in the domain of artificial intelligence to refer to a *formalized* conceptual vocabulary that can be seen as a *shared* and *agreed upon*, explicit representation of a domain (Bench-Capon & Visser, 1997; Chi & Roscoe, 2002; Visser & Bench-Capon, 1998). Ontological knowledge is conceptual knowledge that corresponds to the underlying structure or organization of the domain, and hence, correct conceptual knowledge should be acquired before a domain's ontology can be mastered (see e.g., Chi & Roscoe, 2002).

Research on development of conceptual knowledge and ontology in law supports the statements of Sullivan and colleagues (2007), who not only argued that formal legal knowledge is the first important prerequisite for legal analysis like understanding and categorizing legal problems, but also noted -in line with the interview data we presented- that acquiring the formal legal knowledge is a difficult process. Krieger (2006) demonstrated that novice law school students relied on their lay experiences and commonsense explanations when they had to argue on a case on consumer fraud. Advanced students in his study relied more on formal legal language and were able to identify rules of law when they had to argue on the same case, but they had difficulties applying these rules in drawing inferences. According to Sullivan et al., correct formal knowledge will often be fully grasped only after students have gained experience with various aspects of legal practice.

However, lack of conceptual knowledge is not only a major problem when solving cases; lack of *shared* conceptual knowledge between students, as well as between students and experts, might also have consequences for communication and collaboration, as a shared and agreed upon representation is important for mutual understanding (cf. Bromme, Rambow, & Nückles, 2001). Even when professional roles are not defined by cooperation and a common goal but by dispute and conflict, as in the legal domain, professionals need to share the same ontology to be able to anticipate and react on others' arguments (Ashley & Aleven, 1991).

External information sources

Legal professionals rely heavily on external information sources, such as law books and databases to look up rules, annotations, or court judgments, while reasoning about cases. These external sources can be seen as large collective memory sources (Säljö, 1996) that have to be used to guarantee equality, generalization, repeatability, and predictability of argumentation and judgments (Dop, 2003; Vranken, 2006). Without referring to generally accepted legal sources, it is impossible to judge similar cases equally in distinctive situations and in distinctive courts. For students, however, using these sources can be a daunting task for two reasons. First, searching through these often extensive sources of documentation to find suitable information to apply to a case is difficult when knowledge of the organization of the sources has not been mastered. For example, knowing that the Dutch civil code is divided into one part related to 'persons' and one part related to 'objects' and that the 'object' part is divided in 'absolute' and 'relative' rights, and furthermore, that

the code is composed of general to particular provisions (Vervoordeldonk, 2006) is necessary to search effectively. Without knowledge of the organization of external sources, search will be relatively arbitrary and time consuming. Secondly, correct conceptual and ontological knowledge is also necessary to interpret the information found in the source and to apply it to the case (Sullivan et al., 2007).

Adversarial reasoning

Depending on the professional role one holds, the interest in a case is often quite different (Ashley & Aleven, 1991; Stratman, 2002; Thagard, 1992). For example, an attorney's interest is to create the most optimal perspectives for his or her client, whereas a public prosecutor seeks to bring someone to justice. As a consequence, they will likely focus on other aspects of the case, but this can only be successful if they can take into account -and can anticipate on- the (counter) arguments posed by the other party that has different perspectives and interests. This type of perspective taking, that is, taking into account the possible actions of the opponent to place yourself in the most optimal position, can be compared with playing chess. The goal of chess players is to choose the best possible move on the chessboard, but each option will elicit different potential future moves of the opponent that need to be considered to determine what the best move is (Gobet & Charness, 2006). After every move, 'all' possible future moves should be evaluated again, because after every move the consequences might change. In the legal domain, thinking through possible actions and being prepared for reactions is important to pose convincing arguments without leaving room for others to rebut those arguments (Thagard, 1992; Toulmin, Rieke, & Janik, 1984).

To teach students adversary reasoning skills, they are often assigned to one specific role when they have to reason about a case (e.g., judge, lawyer plaintiff, lawyer defendant). Reading research has shown that specific role assignment strengthens someone's identification with that role (cf. Anderson, Pichert, & Shirey, 1983; Goetz, Schallert, Reynolds, & Radin, 1983). For legal cases this could mean that role assignment could strengthen identification with the interests that have to be protected to solve the case as favourable as possible. One necessary aspect of role taking in adversarial reasoning is that a student should be able to take *different* perspectives to be able to take possible (counter) arguments of the opposition into account. However, if a role is assigned, it might be difficult to take a different perspective because of a highly focused view on specific case aspects (cf. Anderson et al., 1983). Stratman (2002) investigated whether assigned roles (i.e., an advocatory role, an advisory role, a policy role, and a class recitation role) influenced the way in which law students detected and interpreted case information when they worked on the assignment to write an argument in favour of a particular interest. Results showed that students who were assigned to the advocatory role performed better on detecting the underlying legal frameworks of several cases and posed more persuasive arguments than the students assigned to other roles. Stratman hypothesized that students assigned to the advocatory role were better able to identify themselves

with the specific assignment, in such a way that they really felt they had to protect someone's interests and, therefore, focused more on aspects of the case that were relevant for doing so, compared to students assigned to other roles.

In sum, these characteristics of the domain make legal reasoning a complex skill to acquire. In the next section expertise development in complex domains in general will be described, followed by a more specific look at expertise development in the legal domain.

Expertise acquisition in complex domains

Developing expertise can be seen as the acquisition, elaboration, and/or reorganization of cognitive schemas (Boshuizen, 2004; Ericsson, 2006; Sweller, 1988). When novices enter a new domain, their knowledge is limited and fragmented (i.e., not yet organized), and the schemas they have are rather superficial, consisting of few concepts with few relations between them (Alexander, 2003; Boshuizen & Schmidt, 1992; Van de Wiel, Boshuizen, & Schmidt, 2000). Knowledge becomes better integrated the more often concepts are linked with each other and the more often they are activated together in memory (Boshuizen, 2004). Schemas have two important functions in the process of learning and problem solving (see e.g., Boshuizen & Schmidt, 1992, 2008; Sweller, 1988). Next to storage and organization of knowledge in long term memory, schemas also facilitate information processing in working memory during problem solving and learning. When learning new skills, the number of new information elements that can be simultaneously processed in working memory is limited (Cowan, 2001; Miller, 1956). Tasks that contain a high number of new, inter-related information elements therefore impose a high cognitive load on working memory, and for complex tasks this number is usually very high (Sweller, Van Merriënboer, & Paas, 1998). Available schemas can reduce this load, because they integrate several information elements into one (Boshuizen & Schmidt, 2008; Dufresne, Gerace, Thibodeau-Hardiman, & Mestre 1992; Sweller, 1988). However, it is not just the number of information elements that determines task complexity. The degree of structuredness of the task also plays an important role. Complex cognitive tasks require the coordination and integration of multiple, inter-related constituent skills. These constituent skills can be either recurrent (or routine) or non-recurrent (or non-routine; Van Merriënboer & Kirschner, 2007). Recurrent constituent skills rely on algorithmic, rule-based behaviour after training. They are associated with routine task aspects that typically have a narrow problem space, and the correct application of a particular set of operators associated with a problem type always leads to a correct solution. In these situations, problem solving performance can be automated as a result of a lot of practice, because appropriate problem solving operators can relatively easily be recognized and distinguished from inappropriate ones. Non-recurrent constituent skills on the other hand, are associated with non-routine task aspects, meaning they have to be performed in varying ways across problem situations, and therefore one needs a strategy to narrow the search space

and select those operators that are most likely to lead to a solution (e.g., heuristics). However, experts can still perform non-recurrent task aspects far more effectively and efficiently than non-experts, as a result of their experience with many different cases (see e.g., Boshuizen, 2004; Boshuizen & Schmidt, 1992, 2008).

Expertise acquisition in law

Reasoning about legal cases is a complex, ill-structured cognitive task (see also e.g., Blasi, 1995) because it requires the coordination and integration of different kinds of knowledge and skills. With regard to the case this Chapter started with, different kinds of knowledge and skills need to be coordinated and integrated to formulate answers to the questions and leaving no space for others to rebut: knowledge of the correct formal meaning of concepts and terminology (e.g., dissolution, marriage), knowledge of rules and principles (e.g., community of property), being able to recognize structural similarities between current and prior cases that are likely to differ on surface features, the ability to find -and understand- appropriate precedents or legislation based on these relevant features (e.g., judgments of the Supreme Court), knowledge about what is 'reasonable' in accordance with the current norm of rationality and righteousness, the ability to pose counterexamples and take into account possible counterarguments by other parties (e.g., lawyer of Anthony, lawyer of Beatrice), et cetera[2]. Because of the high number of information elements that have to be integrated and coordinated, reasoning about cases will impose a high load on working memory, especially for novice students who lack cognitive schemas to reduce this load and guide their reasoning process. As a result of a lack of conceptual knowledge and knowledge of specific problem solving strategies, complex cognitive tasks such as reasoning about legal cases require novice students to rely on weak heuristics, such as means-ends analysis (i.e., analyzing differences between the current problem state and the goal state to choose operators that can reduce the differences; Sweller, 1988). Although this is a strategy that may allow a student to perform well on solving an unknown problem, it does not seem to be a very efficient one, because it does not contribute much to schema acquisition -and as a result- learning is hampered (Sweller, 1988; Sweller et al., 1998). 'Learning by doing' has been shown in many other domains to be inferior to instructional formats that provide higher degrees of instructional support or guidance, which are much more effective and efficient for novices' learning (Sweller et al., 1998). Therefore, it can be questioned whether 'learning by doing' is an effective instructional strategy for students to learn to reason about cases.

[2] If all relevant knowledge and skills are successfully applied, the conclusion can be formulated that: Anthony can apply for dissolution. After dissolution of the marriage, Anthony and Beatrice both will keep authority regarding the children. And, each may only claim the acquired goods that they brought in individually during the marriage.

Research questions and overview of this dissertation

The aim of the studies presented in this dissertation was to gain more insight in the kind of difficulties students with differing levels of expertise experience when they learn to reason about cases in law school, as well as to investigate instructional formats that might help to diminish or overcome these difficulties. The following research questions are addressed: 1) what are the differences in the structuredness, elaborateness, and accurateness of students' and experts' legal knowledge? 2) how do the availability of conceptual knowledge and information sources affect the process and quality of legal reasoning? and 3) are instructional formats that provide more support than the regular 'learning by doing' approach more effective for learning, and if so, what type of instructional support (i.e., this can be targeted at different processes) is most effective? All of the studies were conducted within the Civil law system, focusing on private law (in Dutch: privaatrecht).

In Chapter 2, a study is presented on expertise-related differences in conceptual and ontological knowledge in the legal domain. The extent and organization of conceptual and ontological knowledge of 24 first-year students, 24 third-year students, and 12 experts were investigated. By means of a card-sorting task, insight was gained into differences in the organization of conceptual knowledge of individuals at different levels of expertise, a concept-elaboration task provided insight into expertise differences in the depth of knowledge about concepts and about associations with other concepts.

Chapter 3 reports a study exploring expertise-related differences in reasoning about cases. The role of conceptual knowledge in reasoning about legal cases was studied, first of all by looking at the reasoning process of 24 first-year students, 24 third-year students, and 12 experts when no external information sources could be used (i.e., a civil code, which normally is available to legal professionals and law students when working on cases). Secondly, insight into the role of conceptual knowledge when using external information sources was gained by comparing the performance of first-year students and third-year students who were allowed to use a civil code to the performance of those who were not.

In Chapter 4, two experiments are reported that build on the findings of the studies reported in Chapters 2 and 3. These findings suggested that students indeed need additional support for reasoning about cases to enhance their learning. The first experiment investigated whether supporting novices' (79 first-year students) reasoning by targeting their lack of conceptual knowledge (i.e., by providing them the meaning of concepts), reducing the cognitive load imposed by search processes (i.e., by providing them a condensed civil code), or both, positively affects learning. The second experiment investigated the effects of providing support for the entire reasoning process, through an outline of process-steps, worked examples, or both, on both 75 novices' and 36 advanced students' learning to reason about cases. In the addendum to Chapter 4, the effects of a field study in which worked examples were implemented in a real law school setting, that is, a first-year course on property law, are described.

Finally, Chapter 5 presents a summary and a discussion of the main findings, in terms of theoretical and practical implications and directions for future research.

The chapters of this dissertation were written as independent articles, and as a consequence, there is some overlap between them.

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Expertise-related differences in conceptual and ontological knowledge in the legal domain

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Little research has been conducted on expertise-related differences in conceptual and ontological knowledge in law, even though this type of knowledge is prerequisite for correctly interpreting and reasoning about legal cases, and differences in conceptual and ontological knowledge structures between students and between students and teachers, might lead to miscommunication. This study investigated the extent and organization of conceptual and ontological knowledge of novices, advanced students, and experts in law, using a card-sorting task and a concept-elaboration task. The results showed that novices used more everyday examples and were less accurate in their elaborations of concepts than advanced students and experts; on top of that, the organization of their knowledge did not overlap within their group (i.e., no 'shared' ontology). Experts gave more judicial examples based on the law book and were more accurate in their elaborations than advanced students, and their knowledge was strongly overlapping within their group (i.e., strong ontology). Incorrect conceptual knowledge seems to impede the correct understanding of cases and the correct application of precise and formal rules in law.

A large body of research on the amount and structure of knowledge of individuals with different levels of expertise exists in various academic and professional domains such as medicine, management, counselling, and physics (see Chi, Glaser, & Farr, 1988; Ericsson, Charness, Feltovich, & Hoffman 2006). Conclusions that have been drawn from those studies are mostly formulated in terms of generalities across domains, which might suggest that they are universally valid. However, there are also large differences between domains and between specializations within domains in terms of the quality and the structure of expert knowledge, which makes it worthwhile to study expertise differences in different domains. For example, Elstein (2001), reviews evidence that the nature of expertise in the medical domain varies among the different specializations. Hunt (2006) has shown that expertise in a specific domain is characterized by specialized domain knowledge and specific (cognitive) skills which do not transfer to performing tasks in other domains.

Research on knowledge structures and knowledge differences in the domain of law is scarce, which is surprising given that the legal domain has some unique characteristics that make it difficult to learn and master (Nievelstein, Van Gog, & Prins, 2008; Sullivan, Colby, Welch-Wegner, Bond, & Shulman, 2007). First of al, novices in law must familiarize themselves with the 'official' use of legal language. This can be difficult, because many concepts that are routinely used in everyday language often have a very specific formal meaning in law (Lindahl, 2004). A second difficulty of the legal domain is that certain concepts (i.e., intermediate concepts) are not confined to one single, fixed meaning. In two different legal situations, those intermediate concepts could have a different meaning depending on the exact situational context (Ashley & Aleven, 1991; Lindahl, 2003; for an example see the section below on 'the role of conceptual knowledge and ontology in law'). Another characteristic of the legal domain is that it is adversarial in nature, that is, it requires students to learn to take multiple perspectives on the same legal problem (e.g., lawyer, prosecutor, judge). From a certain perspective one should act in a certain way to achieve the

obtained goal, but one will only be successful in doing so when possible (counter)arguments of the opposite party are taken into account.

Conceptual and ontological knowledge plays a key role in law: it is prerequisite for correctly interpreting and reasoning about legal cases, and differences in conceptual and ontological knowledge structures between students themselves and between students and teachers, might lead to miscommunication about legal rules and cases. The term 'conceptual knowledge' refers to an individual's entire knowledge base of concepts and relations between concepts, which can be either formally correct or incorrect (Roth, 1990); two people can assign different meanings to the concept society, for example. The term ontology, in its philosophical definition, refers to the conceptual knowledge regarding basic categories of existence in life such as plants, animals and objects (see e.g., Kelly & Keil, 1985) and implies knowledge about the features and underlying principles of those basic categories. Nowadays, the term ontology is often used in the domain of artificial intelligence, where it is defined as a *formalized* conceptual vocabulary that can be seen as a *shared* and *agreed upon*, explicit representation of a domain (Bench-Capon & Visser, 1997; Chi & Roscoe, 2002; Visser & Bench-Capon, 1998), which is the definition we will use here. A cardiologist, for example, should have formal conceptual knowledge about the functioning of the heart. This formal conceptual knowledge can be referred to as a part of the cardiologist's ontology. In sum, ontological knowledge is conceptual knowledge that corresponds to the underlying structure or organization of the domain, and hence, correct conceptual domain knowledge should be acquired before a domain's ontology can be mastered (see e.g., Chi & Roscoe, 2002).

Correct conceptual and ontological knowledge is important for two main reasons. It is required for correct classification of problems and tasks one encounters (Chi, 2005; Roth, 1990), and it is essential for individuals working or studying in the same domain to have a similar understanding of concepts in order to communicate precisely and without misunderstanding about domain-related problems (Klausmeister, 1990). Therefore, studies of how conceptual and ontological knowledge is acquired, are important. Not only can they provide interesting information on the knowledge of participants with different levels of expertise in a domain, but such studies can also ultimately contribute to our understanding of difficulties students experience and the development of (educational) support for expertise acquisition in these domains (see e.g., Boshuizen & Schmidt, 1992; Chi, 2005).

Most studies on law expertise have been conducted in the context of artificial intelligence and the development of legal knowledge systems (Ashley & Brüninghaus, 2003; Bench-Capon & Visser, 1997; Visser & Bench-Capon, 1998). However, as in the context of expertise research, the question of how conceptual and ontological knowledge differs between participants with different levels of expertise in the legal domain, has not received much attention in the Artificial Intelligence context either.

Therefore, the present study investigates expertise-related differences in conceptual knowledge structures and ontology in law. Expertise in the legal domain is interesting to study because this domain has some intrinsic characteristics that make it a difficult to learn and master (Nievelstein, et al., 2008), to which we will return

below. First, we will discuss research on conceptual knowledge structures in some more detail.

Conceptual knowledge structures

Findings from research on expertise differences suggest that experts in a domain have acquired elaborate mental frameworks or schemas that allow them to effectively and efficiently interpret information or problems that they are confronted with. Schemas contain both declarative and procedural knowledge (Chi, 2005; Dufresne, Gerace, Thibodeau-Hardiman, & Mestre, 1992; Schank & Abelson, 1977). When a task or problem for which a schema has been acquired is encountered, the schema will be activated. As a result, the problem is classified as belonging to a certain category and an associated solution procedure is activated with varying degrees of automation depending on the quality of the schema (Anderson, Reynolds, Schallert, & Goetz, 1977). Dufresne et al. suggested that domain-specific knowledge of experts is hierarchically organized in schemas. If experts are confronted with a domain-related problem, a hierarchical, tree-like schema with a top-down problem solving approach including domain concepts and procedures will be activated. Depending on the context and the problem at hand, a specific schema will be activated. The meaning of an activated schema is derived from the kind, the position and the relation between the activated nodes in the schema (Chi, 1997). Novices' problem schemas seem to consist of loosely linked, incomplete, and sometimes incorrect knowledge. Therefore, novices' schemas are less easily activated, and when these schemas are activated, they support problem solving to a lesser extent than experts' schemas do (Boshuizen & Schmidt, 2000; Dufresne et al., 1992).

The role of conceptual knowledge and ontology in law

An important characteristic of the legal profession is that it is very strict about interpreting and relating law concepts. Legal concepts are most important in the profession to interpret and apply legal rules and jurisprudence in a proper way. A difficulty that arises here is that many concepts in law (such as 'demand' or 'verdict') that students know from everyday discourse have a different professional significance (Lindahl, 2004). A similar difficulty is known to arise in physics, where concepts such as *electricity* and *blood flow*, which are known from everyday use, have a different, formal meaning that may only partially coincide with the everyday meaning (Chi & Roscoe, 2002). Everyday knowledge about concepts should be altered into judicial conceptual knowledge, that is agreed upon between individuals working in the domain (i.e., ontology). On top of that, some concepts function as 'intermediate' concepts, which means that they are flexibly interpretable and their exact meaning is determined by specific situational constraints. Depending on the legal situation (the facts) the interpretation of the intermediate concept will differ, as a result of which the legal consequences differ as well (Lindahl, 2003). For example,

the legal situation about one's ownership of a specific amount of money received by inheritance, differs from the legal situation about one's ownership of a bike received as a birthday present from a friend. In the first situation the 'ownership' brings along the duty to pay inheritance taxes, whereas in the second situation becoming an owner of a bike by a gift does not oblige the owner to pay any taxes. So the specific context determines the obtained rights and responsibilities the intermediate concept 'ownership' brings along.

Chi (2005) showed that in physics, concepts could be classified in fixed ontological categories, such as the category of kinematics or the category of flow processes. This is not the case with law concepts. This is on the one hand related to the phenomenon of intermediate concepts, and on the other hand to the fact that problem solving and reasoning in law is often adversarial, that is, performed in a context of debate and disagreement, which requires that one must learn to take multiple perspectives in order to anticipate on counterarguments and exceptions (Thagard, 1992). Despite the strict definitions of legal concepts, it is important that concepts can be *flexibly* applied in distinctive situations.

Uncovering expertise-related differences in conceptual knowledge structures

The present study investigates differences in the structure and content of conceptual knowledge between novices, advanced students, and experts in civil law, using a card-sorting task (De Jong & Ferguson-Hessler, 1986; Trochim, 1989), which requires participants to group (relate) a certain number of given concepts (printed on cards), and a concept elaboration task (Van de Wiel, Boshuizen, & Schmidt, 2000; Van de Wiel, Boshuizen, Schmidt, & Schaper, 1999), which requires participants to verbalize everything they know about a concept in a short time frame (e.g., 2 or 3 minutes).

Card-sorting tasks provide insight into differences in the organization of conceptual knowledge of individuals at different levels of expertise. Because card-sorting tasks do not require students to draw or label links between concepts, however, a concurrent verbal reporting technique will be applied in this study to gather information on why certain concepts are clustered together (cf. Ericsson & Simon, 1993; Van Gog, Paas, Van Merriënboer, & Witte, 2005). Concept-elaboration tasks provide insight into expertise differences in the depth of knowledge about concepts and about associations with other concepts that are spontaneously reported.

Based on previous research that addressed expertise-related differences in conceptual knowledge and ontology using comparable techniques (e.g., Boshuizen & Schmidt, 1992; Van de Wiel, et al., 2000) it is expected that experts' knowledge is not only more elaborate and accurate, but also more structured and organized than students' knowledge. This would show, for example, in experts providing more central concepts around which they structurally group other concepts in the card-sorting task, than advanced students and novices, who are likely to sort concepts in a less organized, unconnected way. Based on previous research on concept knowledge and elaboration (e.g., Chi & Roscoe, 2002; Van de Wiel, et al., 1999), it is ex-

pected that novices will have misconceptions about the formal meaning of legal concepts. This might lead novices to provide more daily examples instead of giving the formal legal meaning in elaborating on legal concepts, because novices only know the concepts from daily life. Moreover, experts could be expected to provide more accurate, formal concept elaborations (and as a result show more overlap - indicative of ontology- with other experts in their card sorting as well) than novice and advanced students.

Specifically, this study investigates expertise-related differences in conceptual knowledge and ontology in the legal domain. It is hypothesized that: 1) as expertise increases, knowledge would be more hierarchically structured and show more overlap with individuals of the same level of expertise, 2) more central concepts would be provided in the card sorting task as expertise increases, 3) novices would order concepts randomly (without any structure) more often than advanced students and experts, 4) concept elaborations would be more accurate as expertise increases (which implies a higher degree of overlapping knowledge and agreed upon explicit representations, i.e., ontology), and 5) novices will give more daily examples in their elaborations than advanced students and experts.

Method

Participants

In total, 48 students involved in private law courses (Dutch specification: 'privaatrecht') and 12 staff members specialized in private law from law schools of Dutch universities participated in this study. They were 24 first-year students (novice group), 24 third-year students (advanced group), and 12 staff members of the faculty of law with on average 5.9 years of professional experience after obtaining their PhD (expert group). Students received a financial compensation of € 10 for their participation.

Materials

Audio recording equipment. Verbalizations were recorded on a laptop computer with Audacity 1.2.4b audio editor (http://audacity.sourceforge.net) using a microphone.

Card-sorting task. The card-sorting task consisted of 30 different concepts, printed on separate cards, that were all in some way related to one main concept in civil law: 'tort'. All concepts were derived from the index of the law book (cf. Crombag, de Wijkersloot, & Cohen, 1977).

Concept-elaboration task. The concept-elaboration task consisted of three central concepts (strict liability, damages, tort/unlawful act), one abstract concept (protective norm), and one intermediate concept (owner), selected from the concepts in the card-sorting task. These concepts were identified as central, abstract and intermediate based on the law book, and this was verified by a domain expert. The central

concepts are concrete terms: the tort itself, one condition, and one consequence of the tort. The abstract concept is an abstract term that is indirectly related to the main concept 'tort'. Finally the intermediate concept can be interpreted in several ways depending on the situation that is characterized. The five concepts were printed on separate cards.

Procedure

Individual sessions of approximately 40 minutes were scheduled at the law schools. Participants first completed the card-sorting task. They were instructed to group the 30 civil law concepts in such a way that the concepts in one group had stronger relations with each other than with concepts sorted in another group. No prompts were given as to how many clusters to create. Participants were asked to verbalize aloud why they put specific concepts together and how these concepts were related to each other, and were instructed to ignore the presence of the experimenter in doing so. Participants then completed the concept-elaboration task. They received the five concepts one by one in random order, and were instructed to verbalize everything they knew about that specific concept, in a fixed time of two minutes per concept. After each individual session, a debriefing took place in which the experimenter asked participants how they felt about the session and provided information about the goal of the study.

Data analysis

The card-sorting task was analysed by means of a hierarchical cluster analysis (cf. De Jong & Ferguson-Hessler, 1986; Trochim, 1989) of unstructured card sort data in SPSS, version 12.0.1. Cluster analysis calculates the strength of the perceived relationships between concepts, and graphically displays these relationships in dendrograms. Each participant's sorting was represented into a 30 × 30 symmetrical matrix, where clustered concepts are represented by 1 and not-clustered concepts by 0. Per group a total similarity matrix was calculated by summing all individual matrices. In the dendrogram, the sub-clusters are listed along the y-axis. The x-axis determines the cluster distance: the smaller the distance (farthest left), the greater the proximity between concepts.

To study the structure of the conceptual knowledge in detail, the total number of clusters participants had made upon completing the task was counted by the experimenter, and based on participants' transcribed verbal protocols it was scored whether the content of every single pile was composed around one central concept or consisted of a string of unconnected concepts. However, it became apparent during data analysis that participants also labelled clusters as belonging to specific fields of law and mentioned specific concepts as 'top concept' to which all clusters could be connected. A top concept differed from a central concept in that it connected all single clusters with each other, whereas a central concept only connected concepts within one cluster.

Coding scheme. For the concept-elaboration task a coding scheme was developed based on concept descriptions in the civil law book (Klomp & Mak, 2005) and based on several kinds of examples. Every 'model' description of a concept in the law book was divided into single elements, which resulted in 10 elements for 'tort', 2 for 'strict liability', 4 for 'damages', 1 for 'protective norm' and 1 for 'owner'. The number of the protocol elements that matched the elements of the 'model' description were counted. Information that was exactly repeated in an elaboration was only counted once (e.g., if the same law book element was mentioned twice or if the same example was given twice, the second time was not counted). The coding scheme is shown in Appendix 1. First, parts of the protocol that corresponded to a law book element were scored. Second, given examples in the protocol were scored. Three types of examples were distinguished: 1) daily examples not related to an element of the concept description in the law book, 2) judicial examples not related to an element of the law book, and 3) judicial examples related to an element of the law book (see Appendix 2).

Two raters independently scored 20 % of the protocols. The inter-rater reliability was .78 (Cohen's kappa). Because the inter-rater reliability was sufficiently high (i.e., higher than .70; Van Someren, Barnard, & Sandberg, 1994), the remaining protocols were scored by one rater. For the analyses we only used the scores of the rater who scored all protocols.

Results

Card sorting task

To address the first hypothesis that more expertise leads to more hierarchically structured knowledge, hierarchical cluster analyses were performed on the data of each group. The resulting dendrograms are shown in Figures 1, 2, and 3. The results of the cluster analyses illustrated that novices show no specific pattern in the way they clustered the concepts. Their clustering was mainly based on connecting two or three concepts that have a basic 'cause-consequence' relationship. Examples are the clusters 'owner'-'ownership' and 'injury'- 'emotional damage'. However, these relationships were not embedded in meaningful clusters. The dendrogram of the advanced students showed that the first and the second strong clusters (proximity level < 0.7) were related with each other at the proximity level of 0.3. Only concepts related to the tenet 'tort' were strongly clustered together. The related concepts reflected the four conditions of a 'tort': 'damage' (and its specific types of damage and damages), 'causality', 'liability' and 'protective norm'. One other strong cluster was made up of the concepts 'owner', 'ownership', and 'object'. These concepts are central to the field of 'property law'. The experts' dendrogram reflected an obvious division between one cluster about the field of 'patrimonial law' (concepts 12 to 20 vertically) in general on the one hand, and a specific split between one cluster about the field of 'property law' (concepts 8 to 23 vertically) and one cluster about the field

of 'law of obligations'(concepts 26 to 22 vertically). This conceptual division corresponded to a detailed 'fields of law' description in a key textbook on Dutch Civil law (Boon, Reijntjes, & Rinkes, 2003), in which important concepts for the different fields are stressed. For example, the concepts owner, ownership and object are stressed as important terms in the field of 'property law'.

To test the second and third hypotheses that experts would provide more central concepts to build their clusters than novices and advanced students, and that novices will create clusters far more often based on randomly ordered concepts than advanced students and experts, the protocol data were analysed. The number of times participants created their clusters around central concepts or constructed clusters with unconnected strings of concepts was analysed by means of ANOVA (significance level set at .05) with level of expertise as independent variable. No differences were found between groups in the number of clusters they made F (2, 57) = 2.39, *ns*. Each group made 7 clusters on average. Table 1 shows the mean number of times participants created clusters a) around central concepts, b) based on randomly ordered, unconnected concepts, c) based on fields of law and d) under top concepts. A one-way ANOVA showed a significant effect of level of expertise for the four types of clusters: clusters created around one 'central concept' F (2, 57) = 10.14, MSE = 2.26, $p < .001$, f = .60, clusters that consist of 'unconnected concepts' F (2, 57) = 12.27, MSE = 5.40, $p < .001$, f = .66, clusters composed around 'fields of law' F (2, 57) = 25.78, MSE = .43, $p < .001$, f = .95, and clusters linked to one 'top concept' F (2, 57) = 8.76, MSE = .12, $p < .001$, f = .55.

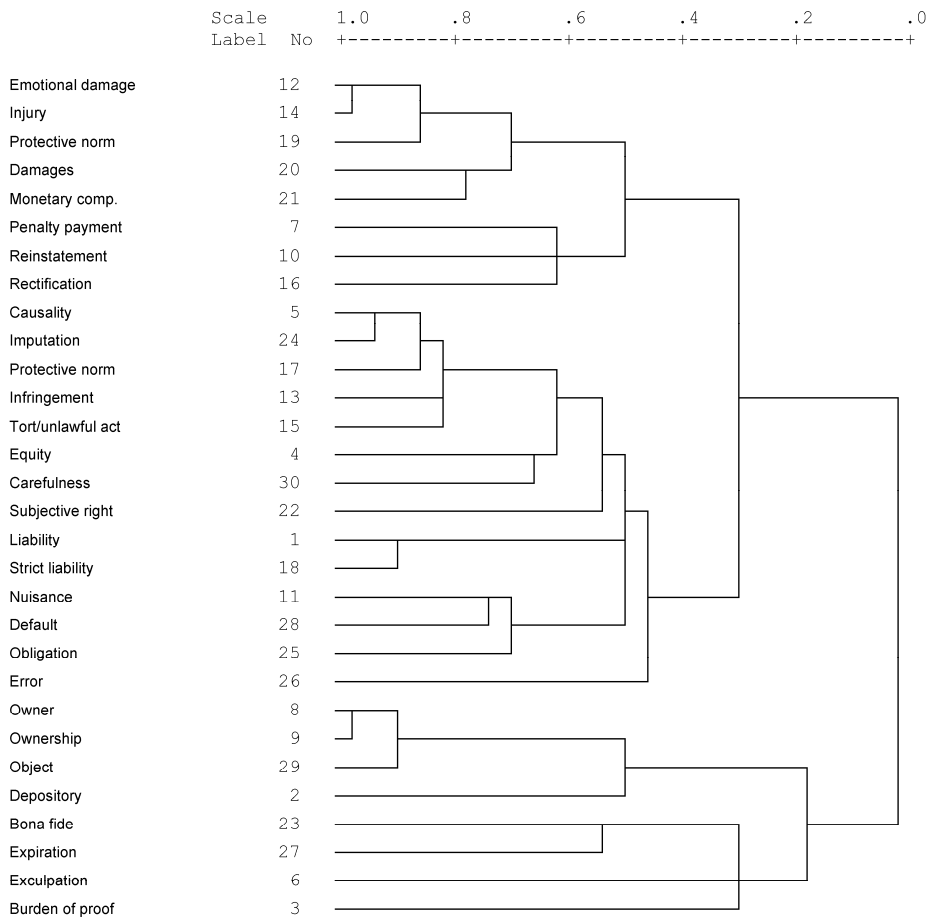

Figure 1. Novices' dendrogram

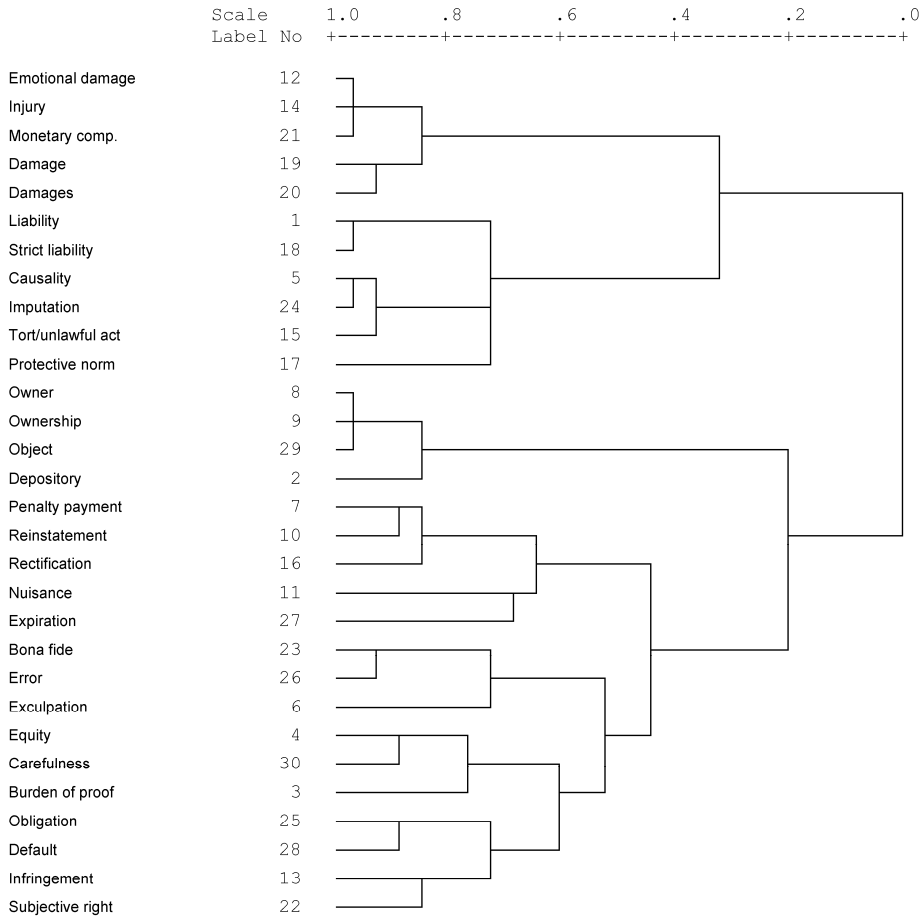

Figure 2. Advanced students' dendrogram.

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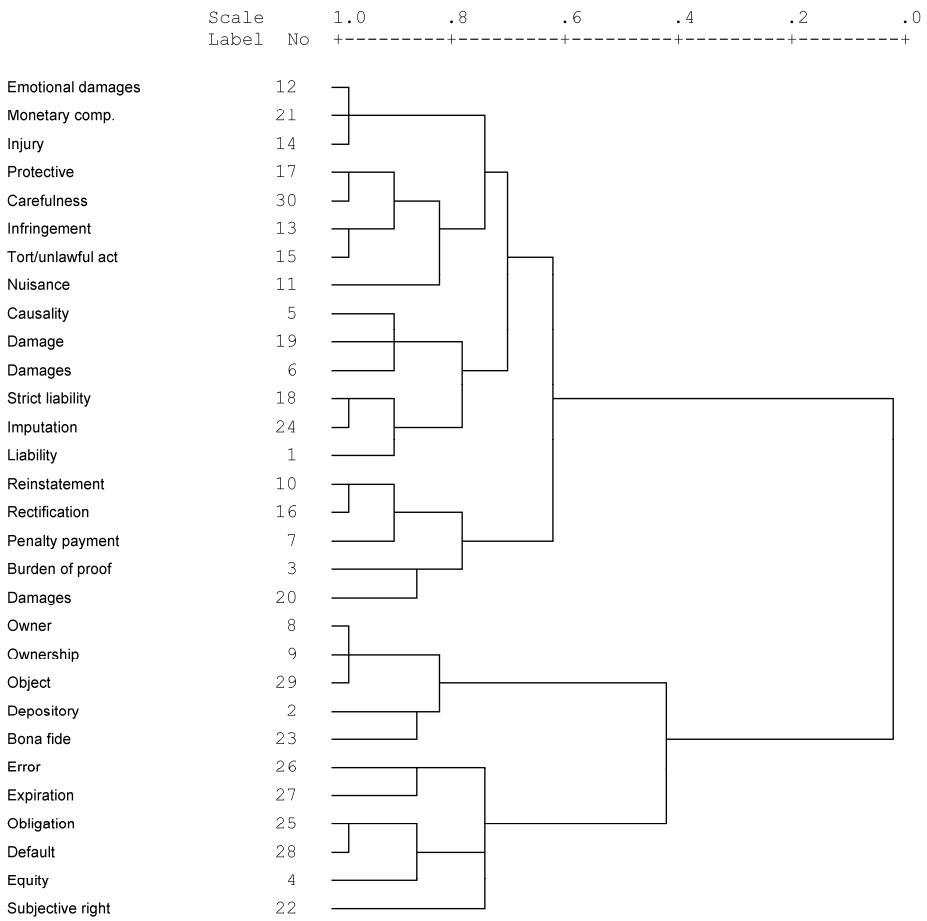

Figure 3. Experts' dendrogram

Table 1. Means for the type of card sort methods per group

	Novices		Advanced students		Experts	
Method	*M*	*SD*	*M*	*SD*	*M*	*SD*
Central concepts	2.12[E]	1.08	2.71[E]	1.27	4.50[N,A]	2.43
Random order	5.17[E,A]	2.85	2.63[N]	2.08	1.50[N]	1.38
Fields of law	0.00[E]	0.00	0.17[E]	0.48	2.17[N,A]	1.47
Top concepts	0.00[E]	0.00	0.08[E]	0.28	0.50[N,A]	0.67

[N, A, E] In post-hoc multiple comparisons (after ANOVA, $p < .05$) significantly different from **N**ovices, **A**dvanced students and **E**xperts.

Bonferroni post-hoc tests (significance level .05) showed that experts mentioned significantly more central concepts, more fields of law and more top concepts while composing the clusters, than both novices and advanced students. Furthermore, it was shown that novices ordered their concept clusters significantly more often on a random basis than advanced students and experts.

Concept-elaboration task

Table 2 shows the means for the elements mentioned accurately with regard to the model description. We hypothesized that with increasing levels of law expertise accuracy of concept elaborations would increase (hypothesis 4). A one-way ANOVA showed a significant effect of expertise on accuracy of all five concepts together F (2, 57) = 17.00, MSE = 4.96, $p < .001$, f = .77. This significant effect is also found regarding the accuracy of the five concepts separately: 'strict liability' F (2, 57) = 12.98 MSE = .28, $p < .001$, f = .67, 'tort/unlawful act' F (2, 57) = 6.45, MSE = 3.19 $p <$ .01, f = .48, 'damages' F (2, 57) = 3.60 MSE = .62, $p < .05$, f = .36,'protective norm' F (2, 57) = 17.90, MSE = .16, $p <$.001, f = .79, and 'owner' F (2, 57) = 15.44, MSE = .17, $p <$ .001, f = . 74.

Table 2. Means for the accurately defined elements per group

	Novices		Advanced Students		Experts	
Concepts	*M*	*SD*	*M*	*SD*	*M*	*SD*
Strict liability (central)	0.25[E]	0.44	0.38 [E]	0.49	1.17[N,A]	0.72
Damages (central)	0.37	0.77	0.17[E]	0.38	0.92[A]	1.31
Tort/Unlawful act (central)	4.13[A]	2.32	2.63[N,E]	1.37	4.58[A]	1.08
Protective norm (abstract)	0.38[E]	0.50	0.17[E]	0.38	1.00[N,A]	0.00
Owner (intermediate)	0.25[A,E]	0.44	0.71[N]	0.46	1.00[N]	0.00
Total	5.38[E]	2.84	4.00[E]	1.56	8.58[N,A]	1.93

[N, A, E] In post-hoc multiple comparisons (after ANOVA, $p < .05$) significantly different from **N**ovices, **A**dvanced students and **E**xperts.

Bonferroni post-hoc tests showed that in line with our hypothesis, experts were significantly more accurate in elaborating on the three central concepts than the advanced students, and that, surprisingly, novices were significantly more accurate in elaborating on one central concept, the 'tort', than advanced students. Furthermore, in line with our hypothesis, experts were significantly more accurate than novices and advanced students in elaborating on the abstract concept and experts and advanced students were both more accurate in elaborating on the intermediate concept than novices. Because intermediate concepts can have a different meaning depending on the exact situational context, this finding suggests that increasing expertise is characterized by the ability to flexibly activate different schemas with regard to a single judicial concept.

Because we expected novices in the domain of civil law to know domain-related concepts from everyday discourse instead of legal definitions, we hypothesized (hypothesis 5) that they would provide more examples in their explanations than advanced students and experts. The number of examples given in the concept-elaboration task were counted, and three types of examples were distinguished. Table 3 shows the mean number of daily examples (i.e., not related to elements of the law book; *Type 1*), judicial examples not related to elements of the law book (*Type 2),* and judicial examples related to elements of the law book *(Type 3*) given in the concept-elaboration task. A one-way ANOVA on expertise differences regarding *Type 1* examples for the five concepts shows a significant expertise effect F (2, 57) = 227.56, MSE = 1.75, $p < .001$, f = 2.83. Bonferroni post-hoc tests showed that novices use significantly more daily examples in their concept elaborations than advanced students and experts. Significant differences between groups were also found in the number of *Type 2* examples given, F (2, 57) = 6.99, MSE = .21, $p < .01$, f = .49. Novices gave significantly more judicial examples which were not related to the elements of the law book concerning the concept content. A one-way ANOVA on expertise differences in *Type 3* examples showed a significant expertise effect F (2, 57) = 20.93, MSE = 8.02, $p < .001$, f = .86. Bonferroni post-hoc tests showed that as expertise develops, participants will use significantly more *Type 3* examples in their elaborations. In other words, advanced students used significantly more *Type 3* examples than novices whereas experts used significantly more *Type 3* examples than advanced students. The data in the table show that experts gave most *Type 3* examples, on average, for the intermediate concept 'owner', whereas novices gave most *Type 3* examples, on average, for the three central concepts 'strict liability', 'damages' and 'tort'.

Table 3. Means for the types of examples given per concept per group: Daily examples not related to the law book (Type 1), judicial examples not related to elements of the law book (Type 2), and judicial examples related to elements of the law book (Type 3).

	Novices						Advanced Students						Experts					
	Type1		*Type 2*		*Type 3*		*Type 1*		*Type 2*		*Type 3*		*Type 1*		*Type 2*		*Type 3*	
Concepts	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Strict liability (central)	2.62^{A,E}	1.28	0.08	0.28	1.42^{E}	1.47	1.00^{N,E}	0.89	0.00	0.00	2.38	1.95	0.00^{N,A}	0.00	0.00	0.00	3.00^{N}	1.65
Damages (central)	2.42^{A,E}	1.66	0.13	0.34	1.00^{A,E}	0.59	0.04^{N}	0.20	0.04	0.20	1.67^{N}	0.76	0.17^{N}	0.39	0.00	0.00	2.01^{N}	1.38
Tort/Unlawful act (central)	2.54^{A,E}	1.06	0.08	0.28	0.96^{E}	0.81	2.00^{N,E}	0.72	0.00	0.00	0.83	0.96	0.50^{N,A}	0.52	0.00	0.00	1.50^{N}	1.51
Protective norm (abstract)	1.92^{A,E}	0.93	0.13	0.34	0.13^{A,E}	0.34	0.00^{N}	0.00	0.04	0.20	0.96^{N}	0.75	0.25^{N}	0.62	0.00	0.00	0.67^{N}	0.65
Owner (intermediate)	2.00^{A,E}	0.93	0.08	0.28	0.50^{E}	0.83	0.00^{N}	0.00	0.00	0.00	0.96^{E}	0.69	0.00^{N}	0.00	0.00	0.00	3.50^{N,A}	1.17
Total	11.54^{A,E}	2.15	0.50^{A,E}	0.66	4.00^{A,E}	1.77	3.08^{N,E}	1.35	0.08^{N}	0.28	6.79^{N,E}	2.52	0.92^{N,A}	0.90	0.00^{N}	000	10.42^{N,A}	4.67

$^{N, A, E}$ In post-hoc multiple comparisons (after ANOVA, $p < .05$) significantly different from Novices, Advanced students and Experts.

Discussion

This study investigated how acquired conceptual knowledge structures differ between novices, advanced students and experts. We hypothesized that 1) knowledge would become more hierarchically structured and would show more overlap as expertise increases, 2) more central concepts would be provided in the card sorting task as expertise increases, 3) novices would order concepts randomly more often than advanced students and experts, 4) concept elaborations would be more accurate as expertise increases and, 5) novices will give more daily examples in their elaborations than advanced students and experts. The results of the hierarchical cluster analyses and verbal protocol analyses support our hypotheses that knowledge becomes more hierarchically structured with increasing expertise. It was shown that experts used the same central concepts to create clusters, embedded in specific fields of law with connections to single top concepts. For advanced students, only their knowledge regarding the tenet 'tort' was hierarchically structured and overlapping, the other concepts were not yet strongly connected nor structured in a hierarchical whole. Novices' knowledge seemed highly fragmented, they strung concepts together while hardly reporting any meaningful connections between concepts, and their clusters were highly idiosyncratic.

These findings suggest that conceptual knowledge networks of novices in the same domain are very different from each other. In other words, even though students are enrolled in the same curriculum, there is no indication of overlapping knowledge (i.e., mastery of ontology) in the very first stage of legal expertise development. However, individuals at a high expertise level have a more similar knowledge base than individuals at lower expertise levels. Furthermore, these findings suggest that with developing expertise in law, knowledge about concepts and the relations between concepts will gradually become hierarchically structured (e.g., third year students' showed hierarchical and overlapping knowledge of 'tort' but not of the other concepts), and eventually, at the expert level, will also be clustered according to different fields of law (a very high level in the hierarchy).

In addition, our hypothesis was supported that experts would be more accurate in elaborating on legal concepts in formal language than novices and advanced students. Unexpectedly, however, novices were more accurate in defining the concept 'tort' than advanced students. A possible explanation for this finding is suggested by the remark of some of the first year students during the debriefing that they had just finished a course component about the tenet tort with an exam, so it is plausible that novices knew the definitions by heart at that moment. With regard to our hypothesis that novices would use more daily examples in their elaborations, the results indeed indicate that novices use a lot of everyday language and daily examples in elaborating on legal concepts. Advanced students used fewer daily examples on average than novices but still significantly more than experts. Furthermore, we found that experts gave most judicial examples for the concept 'owner'. The hierarchical knowledge structure of experts might explain their ability

to flexibly and contextually interpret this intermediate legal concept (compared to the central and abstract concepts). When experts are confronted with an intermediate concept they are able to interpret the concept differently depending on the situated context; a different context activates a different schema.

The results of the cluster analysis and accuracy of elaborations provide indications of ontological differences. It seems that novices have not yet acquired any formal and overlapping explicit judicial representation of these concepts and the domain, which may explain why they rely heavily on their everyday conceptual knowledge. As expertise increases, conceptual knowledge changes into formal knowledge of the domain, which becomes strongly overlapping among experts, indicated by experts' agreement about the kind of concepts reflected in meaningful clusters in the cluster analyses and higher accuracy of their concept elaborations.

This study has some limitations. For instance, we distinguished expertise levels based on years of enrolment, rather than on a pre-test of task or domain specific knowledge. Large within-group expertise differences are unlikely, because the novices were in their first year and had just started, whereas the advanced students were in their third year and had completed half of the curriculum, and because law is not a subject taught in secondary education or encountered easily in extracurricular activities. However, it is possible that some novices have had some prior experience with law before entering the university, or that some third-year students gained less knowledge than their peers during these years of study, making them more similar to novices. A task-specific pre-test (or rapid pre-test; cf. Kalyuga, 2006) would have allowed detection of such possible, though unlikely, exceptions. A related issue concerns the content of the curriculum and the task. The findings regarding the novices' accuracy of elaborations of the concept 'tort' show that certain deviations in results may arise as a consequence of the particular information just provided in the curriculum. A task-specific pre-test could also be used to obtain information about specific differences in prior knowledge within and between groups as a consequence of the curriculum.

As for theoretical relevance of this study, because there are large differences between domains and between specializations within domains in terms of the quality and the structure of expert knowledge, it is worthwhile to study expertise differences in different domains. Some of our findings correspond to those of expertise research in other professional domains, for example that increasing expertise leads to hierarchically structured knowledge (cf. Dufresne et al., 1992; Van de Wiel et al., 2000). Other findings, however, seem to be related to unique characteristics of the legal domain, for example, that the ability to flexibly interpret intermediate legal concepts, depending on the described legal situation, increases with increasing expertise.

Knowledge is a key aspect, but not the sole aspect of expertise (see Ericsson et al., 2006). Thus, future research should also look into how differences in conceptual knowledge influence the ability to reason about legal cases, in order to obtain a more comprehensive picture of expertise acquisition in the legal domain. Another interesting future study would be to use a longitudinal design to investigate how

conceptual knowledge develops with increasing expertise, because the cross-sectional design we used here allowed the investigation of expertise-related differences in conceptual knowledge at certain stages of expertise, but does not allow conclusions on how these differences came about.

Regarding practical relevance, conceptual and ontological knowledge is very important for the correct classification of problems and tasks, as well as for communication in the domain. Moreover, conceptual knowledge is of pivotal importance for legal skills such as reasoning, defending cases from different points of view (e.g., judge, public prosecutor) and taking into account possible actions of the opposition. Hence, studies such as this one not only foster our insight in domain-specific knowledge of participants at different levels of expertise, but can also provide a starting point for more applied future research on how to facilitate knowledge and skill acquisition, as well as communication in the domain. First of all, future studies could develop and study the effects of different kinds of educational support tools. The instruction students nowadays receive in order to learn to argue on cases is mainly by arguing on cases itself. Given the important role conceptual and ontological knowledge plays in this skill, and given that novice students lack this kind of knowledge, this form of instruction might become more effective when additional support is provided (e.g., worked-out examples, process worksheets). Secondly, future research might look into communication processes. Lack of overlapping knowledge (ontology) might complicate communication between students, which could be a problem in collaborative learning settings, and differences in ontology might complicate communication between experts (teachers and professionals) and students (cf. Bromme, Rambow, & Nückles, 2001).

Appendix 1

The coding scheme of the concept elaboration task

Concepts	Coding elements	Total no. elements
Strict liability	The liability of a person committing a tort (**1**) in which it plays no part whether the person him/herself can be blamed for the tort (**1**) (the attribution of the perpetrator occurs, irrespective of this person has 'guilt' in the tort)	2
Damages	Compensation based on statutory regulations (**1**) or based on contractual obligations (**1**). Damages should be paid in money (**1**) however a judge can adjudge other types, no monetary, payments (**1**)	4
Tort/Unlawful act	A tort is a contravention of the law (**1**) or that which, according to common law, the social order becomes (**1**) except for the existence of justification grounds (**1**) a tort is either an infringement on someone's rights (**1**) or an act or a refrain (**1**) whether the perpetrator of the tort is also guilty to pay the damages depends on the following factors: - The behaviour is unlawful (**1**) - There is damage (**1**) - There is a causal connection between the unlawful behaviour and the damage (**1**) - The unlawful behaviour can be ascribed to the perpetrator (**1**) - Relativity and violated standard (**1**)	10
Protective norm	There is no obligation to pay damages in the case the violated standard does not reach to protect against the damage the injured party has suffered (**1**)	1
Owner	Ownership is the most including right an owner has regarding an object (**1**)	1

Appendix 2

Examples regarding type 1, type 2 and type 3 examples of the concept elaboration task

Examples	Examples of specific types
Type 1	a) 'strict liability': 'Strict liability is for example if you know that if you lend your bike to someone and this person falls on the street as a result of which (s)he dies.' b) 'damages': 'For example if someone threatens you with a gun and you cannot sleep anymore, you can claim damages.'
Type 2	a) 'tort': ' If I remember correctly, it is something about the Cohen judgement, with that false employee . . . ' b) 'protective norm' Well I remember an example about a judgement concerning the pollution of a pond. As a result of this pollution a restaurant nearby had fewer visitors. The question was whether this restaurant was protected by the protective norm for it's damages.'
Type 3	a) 'tort': 'A tort is a so-called out of contractual obligation. There are a few situational constraints that point at the presence of a tort: There should be material damage or personal harm, there has to be guilt and causality . . . ' b) 'strict liability': 'For damage, harmed to a third party, through a mistake by a subordinate (employee). The employer is responsible if (s)he created a certain risk to perform a certain task.'

3

Effects of conceptual knowledge and availability of information sources on law students' legal reasoning

This Chapter is in press as:
Nievelstein, F., Van Gog, T., Boshuizen, H. P. A., & Prins, F. J. (in press). Effects of conceptual knowledge and availability of information sources on law students' legal reasoning. *Instructional Science.*

Due to the complexity of the legal domain, reasoning about law cases is a very complex skill. For novices in law school, legal reasoning is even more complex because they have not yet acquired the conceptual knowledge needed for distilling the relevant information from cases, determining applicable rules, and searching for rules and exceptions in external information sources such as law books. This study investigated the role of conceptual knowledge in solving legal cases when no information sources can be used. Under such 'unsupported'[3] circumstances, novice and advanced students performed less well than domain experts, but even experts' performance was rather low. The second question addressed was whether novices even benefit from the availability of information sources (i.e., law book), because conceptual knowledge is prerequisite for effective use of such sources. Indeed availability of the law book positively affected performance only for advanced students but not for novice students. Implications for learning and instruction in the domain of law are discussed.

Reasoning about cases is a key component of the legal profession, and consequently, of legal education. Legal reasoning is a complex cognitive skill (Stratman, 2002), and this complexity results mostly from the characteristics of the legal domain (Blasi, 1995). The legal domain differs from other domains such as medicine or engineering in that during task performance, professionals have to rely heavily on information sources, that is, books of reference such as law books and jurisprudence (Sullivan, Colby, Welch-Wegner, Bond, & Shulman, 2007; Williams, 1992). Consequently, the preferred method of instruction for learning to reason about law cases, is working on cases with the aid of the external information sources professionals in law would use. We argue here, however, that it is questionable whether this method of instruction is the most optimal one, especially for novice students, because they lack correct conceptual knowledge (Blasi, 1995; Deegan, 1995; Lindahl, 2004; Nievelstein, Van Gog, Boshuizen, & Prins, 2008, Chapter 2), which is needed to understand -and reason about- cases and external information.

This study investigates the role of availability of conceptual knowledge in two ways. First, by looking at how expertise influences reasoning about a case when no information sources are available. Second, it is investigated whether the availability of information sources actually helps students, especially novices, in solving legal cases. Before going into detail about the role that conceptual knowledge and information sources play in legal reasoning, we will first shortly describe commonalities and differences in legal reasoning between the Common law and Civil law systems.

[3] In this Chapter the term 'unsupported' is used to refer to the intervention in which students were not allowed to use an information source during reasoning about a case, which is a very unusual procedure in law schools. However, this term should not be taken to imply that the regular situation in which students are able to use this information source, does provide support for their reasoning (see also Chapter 4).

Common vs. Civil law

Despite differences between the systems, reasoning about legal cases is a complex skill both in Common law (Anglo-Saxon) and Civil law (European-Continental; Vandevelde, 1996). To reason about legal problems in Common law, lawyers rely heavily on applying jurisprudence, that is, on solving cases by analogy (Marchant, Robinson, Anderson, & Schadewald, 1993). The structural characteristics (relevant legal facts and context) of a current case should be compared and contrasted with structural features of prior relevant cases to infer whether the same conclusion could be drawn (Aamodt & Plaza, 1994). In high court, a present case always has to be decided according to a past case judgement. In lower court, judges have the right to decide alternatively (Marchant et al., 1993; Vandevelde, 1996). Analogical case-based reasoning also plays a role in the Civil law system, but less pronounced. In Civil law, legal reasoning relies more heavily on interpretation and application of codified legal rules to cases (Stratman, 2004). The legal rules are codified for different law domains, such as in the civil code or the commercial code. Judges decide cases primarily based on the rules, but when the codes and statutes cannot give a decisive answer about the judgement on a legal problem, judges have to base their decision on similar past cases (Vandevelde, 1996). However, both in Common law and in Civil law, conceptual knowledge and the use of information sources (i.e., jurisprudence or codes) play a key role in reasoning about cases.

The role of available conceptual knowledge and information sources in legal reasoning

Conceptual knowledge. Having correct conceptual knowledge is prerequisite for correct legal reasoning (Deegan, 1995; Lindahl, 2004; Lundeberg, 1987; Williams, 1992). First of all, conceptual knowledge is required to understand the legal problem, that is, to decide what information in a particular case is important and what is redundant (i.e., irrelevant). Second, it is necessary to decide what kind of rules or jurisprudence should be searched for, and to interpret and apply these correctly. Nievelstein et al. (2008, Chapter 2) showed that novices and advanced students had less formal and less shared knowledge about legal concepts and the relations between those concepts than law experts. Formalized shared knowledge is referred to as the ontology of the domain (Bench-Capon & Visser, 1997; Chi & Roscoe, 2002). The acquisition of correct conceptual knowledge is a difficult process in many domains, because many concepts that are routinely used in everyday language have a different formal meaning (see e.g., Slotta & Chi, 2006). This also occurs very often in the legal domain (see e.g., Lindahl, 2004; Lundeberg 1987). The findings of Nievelstein et al. also showed that novice students provided naïve and fragmented elaborations of concepts using mostly everyday language. In addition, there was hardly any shared knowledge within their group (i.e., individual knowledge about legal concepts differed enormously). Advanced students had more correct conceptual knowledge, used fewer daily examples, and used more formal legal language than novices, but they did not yet show much shared knowledge either.

Information sources. In solving legal problems, professionals have to rely on information sources such as databases containing jurisprudence, or codes and statutes (Williams, 1992), because every case judgement should be defined precisely (i.e., based on books of reference) in such a way that the judgement can be inferred exactly by others engaged in the legal process (Sullivan et al., 2007). Existing jurisprudence, the exact meaning of rules, and exceptions on rules can be looked up at any time in order to check or substantiate argumentation. However, next to knowledge of how these information sources are organized, conceptual knowledge is also necessary to make effective use of these information sources (Williams, 1992), that is, to find the right rules or jurisprudence, understand this information, and link it to the case.

Legal reasoning

In problem solving, including solving legal cases, a number of general problem-solving phases can be distinguished (cf., Veenman & Elshout, 1995). *Orientation* on the problem/case (i.e., framing the problem), *planning* (e.g., what steps, and in which order, should I take to solve the problem?), *executing* (e.g., elaborating on a problem/case and drawing conclusions), *monitoring* the problem solving process (i.e., in-between evaluations, e.g., am I still on the right track, on time?), and finally *evaluating* the entire process and the final product (e.g., how did I do overall?). Orientation, planning, monitoring and evaluating can be seen as *regulation phases* whereas the *executing phase* consists of elaborating on the problem and drawing conclusions. There is no fixed order through these phases, and phases can be revisited. Expertise seems to influence the amount and duration of engagement in these general processes. In law for example, Lundeberg (1987), compared novices' (i.e., non-lawyers) and experts' approaches of case reading. During case reading, more experts than novices used general strategies; they put the case into context, made an overview, reread, underlined, synthesized and evaluated information from the case. Oates (2006) also showed that during case reading a law professor summarized and evaluated information from the case more often than law students did.

In legal reasoning, the *execution phase* consists mainly of elaborating arguments and drawing conclusions on claims regarding applicability of rules. According to Toulmin's model of argument, elaborating arguments and drawing conclusions can be subdivided into six different steps: *1) grounds, 2) warrants, 3) backings, 4) rebuttals, 5) qualifiers, and 6) conclusions* (Toulmin, Rieke, & Janik, 1984; see also Vandevelde, 1996). For instance, in solving a legal case, a lawyer must first distinguish and extract the legally relevant facts (*grounds*) from the case information. Based on the relevant facts, applicable sources of law referred to as *warrants* (e.g., rules of law and statutes) have to be identified, along with possible additional information like a reference to generally accepted knowledge, norms or jurisprudence, which can strengthen the warrant (i.e., *backings*). These *warrants and backings* have to be compared to the grounds to test whether rules are indeed applicable to these facts. Ap-

plicable rules of law have to be placed in a specific sequence in which the more specific rules will be tested after the more general rules have proven valid. *Rebuttals* are information elements from the case that require the application of exceptions on rules, and the *qualifier* reflects the probability of a legally correct conclusion on the basis of the available grounds, warrants, backings and rebuttals. The final *conclusion* (i.e., judgement) should be drawn, consisting of that which, based on available information, can be asserted.

The present study

The present study addresses how the availability of conceptual knowledge and information sources affects the process and quality of legal reasoning in the Civil law (European-Continental) system.

The first question investigated here concerns the role of conceptual knowledge in legal reasoning. In order to study this question, we compared novices and advanced students with experts in an 'unsupported' condition, in which they could *not* rely on information sources. Because in practice, legal professionals can always rely on information sources when working on cases, it is unclear to what extent they depend on these sources, and to what extent their acquired conceptual knowledge (i.e., their expertise) can help them solve a case. It is hypothesized that: 1) students (novice and advanced) will be less accurate in solving a legal case than experts, and 2) because students have much less conceptual knowledge than experts, we expect differences in the problem-solving process, with students showing less regulation and execution activities than experts.

Probably because legal professionals rely on information sources when solving cases, the preferred method of instruction is having students solve cases with the aid of such sources. However, we argue that even under such 'natural' conditions where students can make use of information sources, it is questionable whether this can help novice students, because adequate use of these sources would also rely on conceptual knowledge, as well as on knowledge of how the source is organized. Lack of such knowledge would probably result in ineffective search strategies when using the information source, which imposes a heavy additional load on working memory (cf. Sweller, Van Merriënboer, & Paas, 1998), thereby reducing the cognitive resources available for reasoning about the case. That is, when a student does not know exactly what (s)he is looking for, or does not know where to look for that information, the search space becomes very large and students may get 'lost' in the search process itself. Consequently, given the limited capacity in terms of quantity and duration of working memory (see Cowan, 2001; Miller, 1956), it will be difficult if not impossible to keep the case details active in working memory, let alone linking possibly relevant information to the case.

Therefore, the second question addressed here is whether novice students can benefit from the availability of an information source (in this study: the civil code). It is hypothesized that: 3a) novices allowed to use the civil code would not be more

accurate in solving the legal case compared to novices who are not allowed to use it, whereas 3b) advanced students who are allowed to use the civil code, would be more accurate in solving the legal case than advanced students who are not allowed to use this source, because contrary to novices, they have sufficient (conceptual) knowledge to find and benefit from the information in the civil code (i.e., they can understand and apply the information). Furthermore, 4) both novices and advanced students' general problem-solving process will be affected by the use of an external source. Those who have more information at their disposal, are expected to show more regulation and execution activities than the advanced and novice students who were not allowed to use the civil code.

Method

Participants

Forty-eight students enrolled in private law courses (Dutch specification: 'privaatrecht') and 12 staff members specialized in private law participated in this study. Students were 24 first-year students (novices) who recently completed an introductory course on civil law, and 24 third-year students (advanced students) who additionally completed two more extensive private law courses. The 12 members of the faculty of law had on average 5.9 years of experience with civil law after obtaining their PhD (experts). Students received a financial compensation of €10 (ca. $14 at the time of writing) for their participation, and experts received a present of about the same amount of money, but were not informed about this in advance.

Design

There are three expertise groups: novices, advanced students, and experts. The novice and advanced students were randomly assigned to a condition in which they could or could not use an information source (i.e., the civil code). This resulted in five conditions: novices without civil code (n = 12), novices with civil code (n = 12), advanced students without civil code (n = 12), advanced students with civil code (n = 12), and experts (without civil code; n = 12).

Materials

Case. A Civil law case printed on A4 paper. This case concerned law of obligations and described a conflict between two civilians (the plaintiff, Mr. S., and the defendant, Mr. D.) about the ownership and the garaging of a sailing boat. Based on the context, five legal claims were described (i.e., right of reclamation, right of retention, costs of garaging, finder's reward, and legal costs; see Appendix).

Civil code. In the civil code (Klomp & Mak, 2005) statutes and rules, applicable in civil procedures, are codified.

Think-aloud instruction and recording. Participants were instructed to argue on the case from the perspective of the defendant's lawyer, and while doing so, to think aloud, that is, to verbalize everything that came to their mind without any restrictions (Ericsson & Simon, 1993). Their verbalizations were directly recorded onto a laptop computer with Audacity 1.2.4b audio editor, using a microphone.

Procedure

The experiment was run in individual sessions. Participants were given a maximum time of 30 minutes to work on the case. First, they were instructed to read the case aloud for up to five minutes. After reading the case, participants were instructed to analyse the case from the perspective of the defendant's lawyer, and to give an elaborate description of how they would solve the problem in the specific case. Students in the conditions with civil code received the additional instruction that they could use the civil code on their desk at any time. In case participants stopped thinking aloud, the experimenter prompted them after about 5 seconds by saying that they should continue to think aloud. The recorded verbalizations were transcribed after the experiment.

Data analysis

Reasoning process. The coding scheme used to analyse the think-aloud protocols in terms of general problem-solving processes was based on the one used in a pilot study by Nievelstein, Boshuizen, Van Bruggen, and Prins (2005), and was further refined with a subset of protocols from the present study. The problem-solving process was categorized by four main regulative categories, that is, Orientation, Planning, Monitoring, and Evaluating, and by two main executive categories, Elaborating and Concluding. Orientation was subdivided into problem orientation (e.g., reading aloud, summarizing, perspective taking, labelling, making assumptions, and identifying knowledge gaps), and into activating domain knowledge (e.g., using conceptual knowledge, using the civil code). Planning concerned remarks about the steps one would or should take to solve the problem. Monitoring concerned in-between evaluations of the problem solving process, whereas evaluations about the final product fell into the category Evaluating. The categories Elaborating and Concluding comprised arguments or conclusions, respectively, with regard to one of the five claims mentioned in the case.

The protocols were segmented and coded based on meaning, that is, parts of the protocol that could be assigned as a whole to one of the categories, were coded as one segment. Two raters independently scored 25 % of the protocols. The inter-rater reliability was .81 (Cohen's kappa). Because this inter-rater reliability was high (.70 is considered sufficient; Van Someren, Barnard, & Sandberg, 1994) the remaining protocols were scored by one rater. Our analysis was based on the total number of codes per problem-solving process category (i.e., the frequencies). The process of segmentation and coding was done with the software program Multiple Episode Protocol Analysis (MEPA; Erkens 2002).

Accuracy of reasoning. To investigate the quality of the argumentations (i.e., the parts of the protocol that were coded as belonging to the executive process categories of 'elaborating' and 'concluding'), a coding scheme based on Toulmin's Model of Argument (Toulmin et al., 1984) was used, which was also tested in the pilot study by Nievelstein et al. (2005). This coding scheme consisted of five out of the six categories: *grounds, warrants, backings, rebuttals* and the *final conclusion*. We decided to exclude the qualifying category because a qualifier would reflect the participants' subjective certainty of the accuracy of the answer, which is more of a regulative statement, and would therefore fall in the Monitoring or Evaluation categories.

Per claim mentioned in the case, elaborations and conclusions given by the participants were expounded in Toulmins' model of argument to reveal completeness of reasoning. The relevant judicial case information regarding to one of the five claims can be seen as the *ground* on which arguments and/or conclusions could be based. First the grounds described in the case (i.e., maximum five) identified by participants, were counted. Parts of the protocol that belonged to the categories of elaborating (i.e., argumentation) and concluding were coded per legal claim as being either a warrant, conclusion, backing or rebuttal. The accuracy of those warrants, conclusions, backings and rebuttals was rated according to an answer model (cf. those used by teachers to grade case elaborations solutions on tests or exams) that contained detailed elaborations of the five claims based on the descriptions of the five claims in the Dutch civil code. For every correct warrant, conclusion, backing and rebuttal, consistent with the answer model, one point was scored. In total 24 points could be assigned.

Results and discussion

The means and standard deviations regarding the accuracy of reasoning, are shown in Table 1, those regarding the reasoning process are shown in Table 2.

Effects of availability of conceptual knowledge

Accuracy of reasoning. In line with our first hypothesis, a planned contrast showed that students were less accurate than experts, that is, the sum of the correct warrants, backings, rebuttals and conclusions for the five different claims in the case, was significantly lower for students ($M = 3.92$, $SD = 3.13$), than for experts ($M = 7.75$, $SD = 3.75$), $t(55) = 3.02$, $p < .05$, $d = 1.11$. The following excerpts from a student's and an expert's protocol illustrate their elaborations on the claim 'right of retention'. Student: '*Well the right of retention I think that it never existed at all. I do not know exactly why because I do not exactly know what the right of retention means . . . '* Expert*: 'Mr D is still the owner of the sailing boat, Mr S cannot claim that he is the owner because Mr S took charge of the sailing boat so he did not become the owner. Mr S should have required an ownership certificate of the sailing boat. Well, let's see. The right of retention existed until the police took possession of the sailing boat . . . '*

However, experts' mean score was not very high: on average, they scored only 7.25 out of 24 points. One might suppose that this score reflects that experts might be able to draw adequate conclusions, but might depend on a law book to provide the exact argumentation, but that was not the case. A closer look at the accuracy scores shows that experts' mentioned only 47% of the correct conclusions, and 30% of the correct argumentation elements according to the coding scheme (i.e., warrants, backings, rebuttals). Therefore, this finding suggests that experts do not only rely on the use of information sources for substantiating their conclusions, but also for drawing them. This is probably because law professionals routinely use information sources when they are working on cases in everyday practice (Williams, 1992). Without having access to those sources, they experience difficulties applying the formal law properly. A quote from an expert protocol can illustrate this. *'Well, this specific problem is more or less similar to a decree I know . . . Hmm, the easiest way to solve this case is to search for this decree . . . but that is not possible now . . . '* Another expert mentioned: *' First I should search in the code what specifically is said about ownership and depository . . . '*

Table 1. The means and standard deviations of reasoning accuracy scores of novice students, advanced students and experts

	Novice students				Advanced students				Experts	
	No code		Code		No code		Code			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Correct total warrants	2.42	1.62	1.83	1.12	1.42	1.00	2.92	1.44	3.42	1.62
Correct total backings	.50	.80	1.50	1.73	.50	.79	1.00	1.71	1.67	1.37
Correct total rebuttals	.17	.39	.08	.30	.08	.29	.42	.79	.33	.49
Correct total conclusions	1.50	1.62	2.17	.72	1.25	1.36	2.33	1.23	2.33	1.37
Correct total elements	4.58	3.60	5.58	2.99	3.25	2.53	6.67	4.66	7.75	3.75

Reasoning process. Contrary to our expectations, a planned contrast showed no significant differences between students and experts on regulation activities: t (55) = -.91, *ns*, and execution activities: t (55) = -.12, *ns*. The fact that experts and students did not differ significantly with regard to their problem solving processes (as the studies of Lundeberg, 1987, and Oates, 2006, would suggest), might also be a consequence of not being allowed to use information sources, which may have interfered with their usual approach to problem solving.

Effects of availability of an information source on students' reasoning

Accuracy of reasoning. In line with our hypothesis, planned contrasts showed that advanced students who could use the civil code were significantly more accu-

rate than advanced students who could not use the civil code, t (55) = -2.33, p < .05, d = .13, whereas no significant difference was found for novices t (55) = -.74, *ns*.

We hypothesized that this would happen, because novices would not profit from the civil code since their lack of conceptual knowledge influences not only their interpretation of the case, but also their ability to use the civil code effectively. It could also be that novices lack knowledge of how the civil code is organized (e.g., were to find the right articles?, what does the numeration mean? etc.), or it might be a combination of both. The following examples of protocol excerpts nicely illustrate this.

Table 2. Means and standard deviations of reasoning process scores of novice students, advanced students and experts

	Novice students				Advanced students				Experts	
	No code		Code		No code		Code			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Mean total protocol elements	33.00	18.17	50.83	21.05	30.67	10.65	46.25	25.63	36.92	15.06
Total number regulative phases	14.75	8.76	34.25	13.31	17.42	9.47	28.67	23.90	20.75	11.52
Total number executive phases	18.25	11.54	16.58	11.41	13.25	4.69	17.58	10.98	16.17	9.24
Orientation (reg)	11.08	8.63	24.25	10.10	11.42	6.75	20.33	16.99	15.33	8.91
Monitoring (reg)	.92	.52	4.33	3.23	.92	1.17	3.33	3.47	2.25	2.63
Planning (reg)	2.08	1.38	3.92	1.78	3.25	2.53	3.33	3.31	1.92	2.02
Evaluation (reg)	.67	.49	1.75	2.49	1.83	1.34	1.67	1.72	1.25	1.42
Elaboration (exe)	11.25	6.90	10.25	8.60	8.42	3.66	11.33	7.38	9.58	5.47
Concluding (exe)	7.00	4.99	6.33	3.55	4.83	1.70	6.25	4.00	6.58	4.44

An example from an advanced student, who was not allowed to use the civil code, illustrates that without using the code, difficulties arise in reasoning about the right of reclamation '*The right of reclamation . . . , well I do not know by heart what it exactly means . . . if I had the possibility to search in the civil code I would first look to at the period of limitation. . . . '* The following example from a novice who could not use the civil code, seems similar, except that the advanced student is more specific in *what* (s)he would look for in the code: *'Oh no, I do not know what the definition of the right of retention is . . . I do not know what ownership exactly encompasses . . . I actually need a civil code to search for it . . . '*. So both novice and advanced students indicate they need the code. However, when the civil code is available, the following example illustrates what happens when a novice starts searching for information, in this case also concerning the right of retention: *' The right of retention, hmm, I will look immediately at article 8. 945, hmm lets see 8. 945, I will go back. . hmm the code jumps from article 910 directly to 7, I first see article 908 and then 7.1 hmmm ok, that is not what I am looking for.'*

This novice seems to experience problems finding the right information; (s)he does not know exactly what information (s)he is looking for and where it can be found. This is in marked contrast to the following excerpt from the protocol of an advanced student who could use the civil code, which illustrates that (s)he could not only find the right information regarding the right of reclamation, but could also link the information from the civil code to the information in the case regarding the claim: '*In this case Mr D has the right of reclamation because the civil code says: 'that the owner of an object has the authority to claim the object from every person who keeps the object without permission' . . . '*

Reasoning process. It was found that novices who could use the civil code made significantly more regulative comments, t (55) = -3.30, p <.05, d = 1.73. than novices who could not use the civil code. This finding is probably due to the (ineffective) search processes in the civil code, and reflects 'negative' remarks concerning regulation (e.g., 'I cannot find what I am looking for'). The following excerpt from a novice with the civil code illustrates that using the code leads to regulation even if the student has difficulties understanding the formal information: '*First I will search in the civil code what specifically is said about the right of retention, let's see hmm, ok, here it is said: 'The right of retention means the authority, indicated by law, the creditor has to postpone the fulfilment of obligation until the claim is paid by the debtor' . . . well ok hmm, what does this all mean . . . ?*' Contrary to our expectations, there were no significant differences between advanced students who could and could not use the civil code both on regulation activities: t (55) = -1.90, *ns*, and execution activities: t (55) = -1.07, *ns*. So even though advanced students were able to benefit from the availability of the civil code in terms of accuracy, this did not seem to affect the amount of engagement in general reasoning processes, although it must have influenced the content.

Conclusions and implications

This study investigated the effects of the availability of conceptual knowledge on legal reasoning by comparing the accuracy and process of reasoning of students and experts when they could only rely on their knowledge. It was found that experts performed better than students, but that their performance was still rather low. This study provides an indication of the extent to which experts depend on information sources when reasoning about cases. They do not only seem to need such sources for substantiating conclusions, but also for working towards conclusions.

Next, we investigated the effects of the availability of the civil code on the accuracy and process of novice and advanced students' legal reasoning. As we hypothesized, the availability of the civil code improved legal reasoning for advanced students, but not for novice students. Lack of conceptual knowledge and lack of knowledge of how information sources are organized, both by themselves or in combination, indeed seemed to lead to ineffective search processes when using the information sources. Such processes impose a high additional and ineffective (i.e., extraneous) load on working memory, that is, this load is not imposed by processes that

contribute to the quality of the task performance (for a discussion of cognitive load theory, see Sweller et al., 1998; Van Merriënboer & Sweller, 2005).

The findings strongly suggest that current instructional methods for novice students in law school are suboptimal. Law education relies heavily on the idea that students learn to reason about -and to solve- cases by engaging in solving cases (with the aid of external sources) from very early on in their trajectory. However, the results from the current study suggest that novices may learn very little from this form of instruction, that is, their performance does not seem to improve from being allowed to use the civil code compared to not having an information source available at all. Therefore, novice law students might need different forms of instruction, or more instructional guidance to help them learn to solve cases more effectively. Research on scaffolding or fading instructional guidance has shown that providing high levels of support initially (e.g., by reducing the amount of search required through the use of worked examples or by other means) and then slowly fading this out with increasing student expertise/knowledge, makes the learning process more effective and efficient (see e.g., Kalyuga, Ayres, Chandler, & Sweller 2003; McNeill, Lizotte, Krajcik, & Marx, 2006; Renkl & Atkinson, 2003; Van Gog, Paas, & Van Merriënboer, 2008). Future studies should investigate whether forms of instructional guidance, such as scaffolding conceptual knowledge, or diminishing the additional cognitive load imposed by the search process in the civil code (e.g., by giving students not a full, but a condensed version containing only relevant information), are more effective and efficient for novices than the 'traditional' method of instruction. Concerning scaffolding of conceptual knowledge, an important question is what the most optimal technique would be, and the answer likely depends on the type of concepts as well. It may be that providing the students with the definition of concepts suffices, however, the meaning of some legal concepts may vary according to the context (Lindahl, 2004; see also Nievelstein et al., 2008, Chapter 2), and learning these may therefore depend on repeated encounters with the concept in several different contexts and cases. In this case one might consider annotating concept definitions in different cases and requiring students to make comparisons between the meaning of the concepts in the cases.

It is impossible to imagine the law profession without the availability of external information sources, yet this study showed that the influence of these sources -and learning how to use them- on legal reasoning should not be underestimated. There is a difference between the way the profession is practiced and the way novices should be taught to become a practitioner in the domain. Even though the approaches to solving legal cases differ in Common law and Civil law, the current findings may also apply to the Common law system. Conceptual knowledge plays an equally important role in Common law, and even though the information sources used may differ (e.g., documented jurisprudence) the ineffectiveness of search processes when using these sources may not be that different. However, it would be interesting to test this in future studies.

Appendix - Private law case

'The Sailing Boat'

Mister Schip (S) exploits a boat garaging. In a harbour lies the pilot of mister Schip of which he is the owner. March 1999, a wooden sailing boat (from now: the boat) is stolen from mister Duinstra (D). Mister D reported this theft by the police. September 2000, an unknown person requested mister S to store a boat in his pilot; S accepted and garaged the boat in his garaging. At the end of June, mister D sees by accident that his boat is stored in mister S' garaging, and he let S know that he is the owner of the boat. D requests S to hand over the boat. S is willing to do this on condition that D pays the garaging costs. D refused. July, 25th 2004, D reported his discovery by the police. August the 1st 2004, the police attached the boat and mister S is questioned as suspect of the theft by the police. October 30th 2004, the public prosecutor decided that the boat must be returned back to mister D. Then this occurred. The criminal case against S is dismissed by the public prosecutor because of insufficient valid evidence. December the 6th 2004, mister D is summoned by mister S to appear in court. On the one hand, he claimed mister D to hand over the boat to him (S), on the other hand, conviction of D primary to pay the amount of € 3600, and secondary to a reasonable amount of finders' reward. Finally, S claims D in order to pay the legal costs. S founded this claim by stating that he has a right of action mattering the garaging costs of the boat as well as right of retention on the basis of which he has right to reclaim the boat.

How would you handle the case if you were mister D's lawyer?

4

The effects of instructional support in complex domains: learning to solve legal cases

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Despite differences in law systems between countries, a common approach to teaching students to reason about cases, is 'learning by doing,' that is, reasoning about lots of cases repeatedly with the aid of external sources professionals also use. However, reasoning about legal cases is a complex skill to acquire, and there are indications that this essential aspect of teaching law is less than optimal, especially for novice students. Two experiments are presented here that show that instructional support can improve students' learning to solve cases. Experiment 1 investigated the effect of supporting novices by targeting their lack of conceptual knowledge necessary for reasoning about cases (i.e., providing meaning of concepts), by reducing the cognitive load imposed by search processes (i.e., providing a condensed code), or both. Reducing the amount of search required during learning led to higher performance on a test case. Experiment 2 investigated the effects of supporting reasoning itself through an outline of process-steps and of worked examples, for novices and advanced students. Studying worked examples substantially increased performance on a test case for both novices and advanced students.

Irrespective of their legal specialization (e.g., solicitor, judge, public prosecutor, legal advisor), reasoning about cases is probably the most important activity for professionals in the domain of law (Blasi, 1995; Lundeberg, 1987; Stratman, 2002; Williams, 1992). Almost daily, they solve problems and make decisions founded on legal rules and documented previous decisions of the court (i.e., jurisprudence/court judgments; Blasi, 1995). In Civil (European-Continental) law, the primary sources of jurisdiction are documented laws, whereas court judgments are used to a lesser degree. Jurisdiction in Common (Anglo-Saxon) law is more grounded on court judgments, whereas documented laws are secondary sources. The backbone of virtually all law school curricula, regardless of the exact educational formats used (e.g., lectures, self-study assignments, collaborative learning assignments, tutorials, moot courts; on which different law schools place different emphasis, Teich, 1986) is that learning to reason about cases is held to be best acquired through 'learning by doing', that is, by engaging in solving many cases with the aid of information sources professionals can also use (see Sullivan, Colby, Welch-Wegner, Bond, & Shulman, 2007; Vranken, 2006; Williams, 1992).

Instructional design research has shown, however, that 'learning by doing' is not the most effective nor efficient way of knowledge and skill acquisition, rather, students (especially novices) often learn better and faster with instructional formats that provide more support or guidance (Sweller, Van Merriënboer, & Paas, 1998). However, studies on the effects of instructional support have thus far mainly focused on more structured domains (e.g., math or science problems) and it has been argued that it is unclear whether these findings would also apply to more complex, that is, less structured or ill-structured domains such as law (Rourke & Sweller, 2009; Schmidt, Loyens, Van Gog, & Paas, 2007).

Research in the legal domain has suggested that a 'learning by doing' approach to acquiring reasoning skill entails serious problems for students, especially novices, as they lack knowledge of the formal legal language, which is necessary to understand and reason about cases (Blasi, 1995; Deegan, 1995; Lindahl, 2004; Nievelstein,

Van Gog, Boshuizen, & Prins, 2008, Chapter 2). Moreover, effective use of information sources not only requires knowledge of how the source is organized, but also relies to a large extent on knowledge of the formal legal language. A study by Nievelstein, Van Gog, Boshuizen, and Prins (in press, Chapter 3) has indeed shown that novice students' performance on a case did not improve by using a civil code compared to a situation where they did not have a civil code at their disposal. Advanced students did, however, perform better when they could use the code, as one would expect. This suggests that novice law students may need a different kind of instructional approach -one that involves more support- for learning to reason about cases. Two experiments are presented here that investigate this assumption. Before describing these experiments, we will first address some of the difficulties students encounter in learning law in more detail.

Complexity of the legal domain

Reasoning about law cases is a complex task that encompasses the integration of different interrelated information elements and the coordination of different cognitive processes during several stages of problem solving. For example, students have to read cases, formulate questions, search for applicable laws and provisions, check whether rules and provisions can be applied to the case, and finally, provide convincing, substantive argumentation to those questions (Blasi, 1995; Sullivan et al., 2007). In integrating and coordinating those different processes, conceptual knowledge plays a pivotal role. Knowledge of relevant legal concepts is required to understand the case and to frame the problem in the correct legal context (Deegan, 1995; Lindahl, 2004). Furthermore, to determine the most relevant information in the case, what the underlying legal framework is, and which laws might therefore be most applicable, students should know the formal meaning of legal concepts (Lundeberg, 1987; Sullivan et al., 2007; Vranken, 2006). Two complications arise here. First, students are often hindered by intuitive, everyday ideas about many concepts when they start to study law, which need to be changed into formal meanings (Lindahl, 2004; Lundeberg, 1987; Nievelstein et al., 2008, Chapter 2; similar problems also occur in other domains, for example in physics, see Chi, 2005; Vosniadou, 1994). Second, the meaning of some concepts varies with the context of the case. That is, in a different context, the same concept can have other implications (Lindahl, 2003; Vranken, 2006). An example, is the concept 'property' that does not always have the same implication (Vervoordeldonk, 2006). Depending on the context, it can mean a tangible object, or it can imply the right of ownership. Therefore, the context of the case in which concepts are embedded is important to abstract their exact meaning.

Another difficulty is related to the need to identify potentially applicable laws to the case which also requires searching in external information sources such as law books or legal databases containing court judgments. The use of such external sources plays an important role in this profession because lawyers need to exactly

qualify and verify possible applicable laws and/or court judgments to single cases. The importance of this strict qualification and verification is to achieve equality, generalisation, repeatability, and predictability of jurisdiction (Vranken, 2006). Again, conceptual knowledge is important to understand the information found. However, to be able to search effectively, knowledge of the organization and indexing of the information source is also required. Knowledge about the organization of the Dutch civil code, for example, would be knowing that the code starts with general and ends with particular provisions, that it consists of one part related to 'persons' (i.e., law of persons) and one part related to 'properties' (i.e., law of property), et cetera. This kind of knowledge might reduce the search space, but novices usually also lack this. In sum, while searching through sources, not only the information in the case and the information searched for should be kept in mind, but the information that is found also needs to be interpreted in light of the case information and/or in light of other laws or court judgments referred to in the source.

Finally, reasoning about a case requires that students substantiate arguments convincingly, and to do so, they also need to consider possible counterarguments from opposing positions. This is necessary because of the adversarial nature of the legal domain: different parties (i.e., lawyer, judge, public prosecutor, legal advisor) have different interests and therefore different perspectives on the same case (Thagard, 1992).

Expertise development and instruction

Learning can be seen as the acquisition, elaboration, and/or reorganization of cognitive schemas (Boshuizen, 2004; Chi, Glaser, & Farr, 1988; Schank & Abelson, 1977; Sweller, 1988). Schemas combine related information elements into one single element and have two important functions in the process of learning and problem solving (see e.g., Boshuizen & Schmidt, 1992, 2008; Sweller, 1988). First, they facilitate storage and organization of knowledge in long term memory, and second, they also facilitate information processing in working memory during problem solving and learning. When learning new skills, the number of new information elements that can simultaneously be processed in working memory is limited (Cowan, 2001; Miller, 1956). The number of new, inter-related information elements a task contains, determines the cognitive load it imposes on working memory (see for reviews of cognitive load theory: Sweller et al., 1998), because a schema can be treated as a single element in working memory, and it can serve as a framework for processing new information. Available schemas, therefore, reduce the load imposed on working memory (Boshuizen & Schmidt, 2008; Sweller, 1988). Moreover, sometimes schemas can be automated through practice, in which case working memory load is further reduced because such schemas no longer require controlled, effortful processing (Shiffrin & Schneider, 1977).

Whether or not schemas can be automated, depends on their nature. As mentioned before, law is a complex cognitive domain. Complex cognitive tasks require

the coordination and integration of multiple, inter-related constituent skills, and these constituent skills can be either recurrent (or routine) or non-recurrent (or non-routine; Van Merriënboer & Kirschner, 2007). Recurrent constituent skills rely on algorithmic, rule-based behaviour after training. They are associated with routine task aspects that typically have a narrow problem space, and correct application of a particular set of operators associated with a problem type always leads to a correct solution. Therefore, problem solving performance can be automated as a result of a lot of practice, because appropriate problem solving operators can relatively easily be recognized and distinguished from inappropriate ones. Non-recurrent constituent task aspects on the other hand, are associated with non-routine task aspects, meaning they have to be performed in varying ways across problem situations, and therefore one needs a strategy to narrow the search space and select those operators that are most likely to lead to a solution (e.g., heuristics).

However, even though they cannot be fully automated, experts can perform non-recurrent task aspects far more effectively and efficiently than non-experts as a result of their high-quality, well-structured schemas. With developing expertise, schemas become more elaborated, refined, and integrated with other schemas, making them better accessible during problem solving, but novice students' knowledge is limited, fragmented and not yet organized (see e.g., Boshuizen, 2004; Boshuizen & Schmidt, 1992, 2008; Custers, Boshuizen, & Schmidt, 1998). Because they have yet to develop memory structures that contain rich networks of concepts, and specify significant relationships between those concepts, novices have difficulties to interpret, evaluate, integrate and combine new information elements. As a consequence, complex cognitive tasks such as reasoning about legal cases require them to rely on sub-optimal strategies, such as means-ends analysis (i.e., analyzing differences between the current problem state and the goal state to choose operators that can reduce the differences). Although this might be a good strategy to solve an unknown problem (i.e., *performance*), it poses very high load on working memory and does not seem to contribute much to *learning* (Sweller, 1988; Sweller et al., 1998).

In sum, given the complexity of the domain and its consequence for learning and expertise development, it can be questioned whether 'learning by doing' is the most optimal instructional strategy for learning to reason about legal cases. Novice law students are presumably seriously hampered by their lack of knowledge of the formal legal concepts and problem solving schemas, which play such a pivotal role in interpreting the case information, searching in information sources, determining the underlying legal framework, identifying applicable laws, looking for counterexamples, and substantiating arguments convincingly (Deegan, 1995; Lindahl, 2004; Lundeberg, 1987; Sullivan et al., 2007).

This suggests that novices need additional instructional support when engaging in reasoning about cases to enhance their learning. Such support can be targeted at different processes. The first experiment investigates support focused on conceptual knowledge and the use of an external information source. The second experiment investigates support focussed on the entire reasoning process, by means of general

process-steps and worked examples. Both experiments are conducted in a Civil (European Continental) law context in the field of private law.

Experiment 1

The findings of Nievelstein et al. (2008, Chapter 2) and Nievelstein et al. (in press, Chapter 3) showed that novices have difficulties with reasoning about legal cases because of their lack of knowledge -and everyday interpretation- of legal concepts, and that novices were not able to take advantage of a civil code: their performance did not improve compared to not having any information other than the case description at their disposal. However, it is unclear from these findings whether (1) lack of conceptual knowledge hinders students' understanding of the case, the underlying legal framework, and the external source, or whether (2) the search process in the external source itself -while keeping in mind the relevant case information- imposes an ineffective load on working memory and as a result, hinders learning, or (3) -most likely- whether it is an interplay of those two possible causes. Therefore, this first experiment investigates whether learning to solve cases is improved by a) providing novice law students with explanations of the meaning of relevant formal concepts (e.g., 'purchase', 'owner', and 'hire agreement') along with the case description, which would help them to make sense of the case information, and b) reducing the search space in the civil code by providing learners with only the articles that represent the rules of law of the code (i.e., condensed civil code) that need to be used when solving the cases we presented. If lack of correct conceptual knowledge leads to learning difficulties, because novices have difficulties understanding and abstracting the relevant case information and the underlying legal framework, the instructional format in which *concept explanations* are added to the case would be expected to lead to better learning. If, however, the extensive search space -caused by a complete civil code- causes the learning difficulties, because it imposes high ineffective load (i.e., extraneous cognitive load) on working memory, the instructional format in which students can use a *condensed civil code* would be expected to lead to better learning. If both lack of conceptual knowledge and the ineffective load imposed by the search process are the cause, a combination of providing both *concept explanations* and *condensed civil code* would be expected to lead to better learning.

Method

Participants

Seventy-nine first-year law students from a Dutch university volunteered to participate in this study. They were novices on the topic of private law (i.e., they had not yet started with the introductory course on civil law). For their participation, stu-

dents received a financial compensation of €10 and a small amount of course credit on a written exam.

Design

A 2 x 2 factorial design with the factors Concept Explanations (Yes/No) and Civil Code (Condensed/Complete) was used. This leads to four conditions: 'Concept Explanations – Condensed Civil Code' (n = 20), 'Concept Explanations – Complete Civil Code' (n = 20), 'No Concept Explanations – Condensed Civil Code' (n = 20), and 'No Concept Explanations – Complete Civil Code' (n = 19).

Materials

Electronic experimental environment. All materials (a pre-test, a post-test, two learning tasks, one test task, and mental effort rating scales) were presented in a web-based electronic experimental environment. The environment logged participants' responses and time-on-task.

Pre-test and post-test of conceptual knowledge. A pre-test and post-test were used to measure conceptual knowledge before and after the experiment. The tests consisted of the 21 concepts (e.g., 'owner', 'transfer of property', and 'gift') that were also used in the problem description of the learning tasks and test task. Students were required to give their definition of the concepts, or to mark 'I do not know' if they did not know the meaning of a concept.

Learning tasks. The learning tasks consisted of two civil law cases with the same underlying theme, namely ownership and transfer of property, but with different contexts. The context of transfer of property (i.e., a pair of skis) in the first learning task had the sequence of hire – sell – gift. That is, person A hired a pair of skis from person X, then sold the skis to person B, who in turn gave the skis to person C as a present. The context of transfer of property (i.e., high-pressure pistol) in the second learning task had the sequence of hire – gift – gift. That is, person A hired the high-pressure pistol from person X, gave the pistol to person B as a present, who in turn, gave the pistol to person C as a present. The learning tasks appeared in text on the computer screen. Below the learning tasks was a typing window in which students were required to write their argumentation about who became owner of the object after the transfer of the skis and the high pressure pistol, respectively. There was no limitation on the number of characters that could be typed in this window. The complete civil code consisted of the civil code collection of Dutch legislation. The condensed civil code consisted of only those articles participants needed -twelve in total- in order to solve the cases, copied on seven pages of A4 paper. The concept explanations concerned the same 21 concepts that appeared in the pre-test and post-test. In the concept explanation conditions, definitions of the concept were presented on the right side of the computer screen next to the learning task and were visible continuously until the task was completed.

Test task. The test task consisted of a case that was again about ownership and transfer of property, but the context of transfer of property (i.e., a scooter) in this test

task had the sequence of hire – gift – sell. That is, person A hired a scooter from person X, gave the scooter to person B as a present, who in turn, sold the scooter to person C. It was presented in text on the computer screen, with a typing window below the task, in which students were required to write their argumentation about who became owner of the object after the transfer of the scooter. Concept explanations were no longer provided and all participants had to use the complete civil code.

Mental effort rating scale. Invested mental effort was measured using the 9-point subjective rating scale developed by Paas (1992). The scale ranged from *very, very low mental effort* (1) to *very, very high mental effort* (9). This scale is a reliable measure of actual cognitive load (i.e, the cognitive capacity that is actually allocated to accommodate the demands imposed by the task) and is sensitive to variations in task complexity between and within tasks (see Van Gog & Paas, 2008).

Procedure

The experiment was run in two-hour group sessions with approximately 20 students per session in a computer room at the law school. In each session, participants were randomly assigned to conditions (i.e., conditions were not tied to sessions), by having the experiment leader randomly hand out login codes that ascribed participants to one of the four conditions. With login codes that applied to the condensed civil code condition, participants also received a version of the condensed code. The other students were told to use their copy of the complete code, which all participants had been asked to bring along. The students worked individually at their own pace. Students first received a short oral explanation about the experimental procedure. They were instructed to log on to the electronic learning environment and told to follow the directions on the screen. All students first completed the pre-test. Then, all students worked on the same two learning tasks one after another, with or without the support of the concept explanations and with the instruction to either use the complete or the condensed civil code, depending on their assigned condition. Before starting the test task, students in the condensed civil code condition had to hand in the condensed code to the experiment leader, and students in all conditions were instructed to use their complete civil code during the test task. After completing the test task, they received the post-test. Students had to mark how much mental effort they invested in the pre-test, in each learning task, in the test task, and in the post-test on the 9-point rating scale that appeared on the computer screen directly after completion of each of those tests or tasks. After rating the mental effort on the post-test, participants were automatically logged out of the system.

Data analysis

Concept definitions provided in the pre-test and post-test were rated according to their formal definitions in a Dutch legal dictionary (Algra et al., 2000). The formal

definitions of the concepts consisted of either one, two, or three parts. For each of these parts correctly mentioned, one point was assigned. A total of 34 points could be gained.

Performance on the test task was analysed according to a scoring model developed by a private law professor, comparable to the models used to score examinations. The weight (number of points to be gained) ascribed to each argument, depended on the importance of the argument to reach the correct solution. In total 100 points could be gained.

Results

Table 1 presents the means and standard deviations of the performance, mental effort, and time on task data per condition. For the analyses reported here, Cohen's *f* is provided as a measure of effect size with .10, .25, and .40, corresponding to small, medium, and large effects, respectively (Cohen, 1988).

Due to a server connection failure, pre-test data of eleven participants were not logged (i.e., 'Concept Explanations – Condensed Civil Code' $n = 4$, 'Concept Explanations – Complete Civil Code' $n = 1$, 'No Concept explanations – Condensed Civil Code' $n = 3$, and 'No Concept Explanations – Complete Civil Code' $n = 3$), those participants were excluded from the pre-test analysis. A one-way ANOVA showed no significant differences between groups on the pre-test $F(3,64) = 1.19$, $p > .20$, so students in the different conditions did not differ on prior knowledge of concepts.

Test performance. A 2 x 2 ANOVA with factors 'Concept Explanations' and 'Condensed Civil Code' showed a significant main effect of 'Condensed Civil Code' on test task performance $F(1,75) = 15.46$, $MSE = 147.01$, $p < .001$, $f = .11$, indicating that students who had used the condensed code during the learning phase ($M = 23.37$, $SD = 14.42$) scored better on the test (using the complete code) than students who had used the complete code during learning ($M = 12.74$, $SD = 9.67$). There was no significant main effect of 'Concept Explanations', $F(1,75) = 3.40$, $MSE = 147.01$, $p = .069$, nor a significant interaction effect, $F(1,75) = 0.97$, $MSE = 147.01$, $p > .20$.

Knowledge gain. Due to a server connection failure, the post-test data from eight participants were lost (i.e., 'Concept Explanations – Condensed Civil Code' $n = 3$, 'No Concept Explanations – Condensed Civil Code' $n = 2$, and 'No Concept Explanations – Complete Civil Code' $n = 3$). Combined with the lost pre-test data (i.e., for some students pre-test data and for others post-test data was lost, and for some students both), pre- to post-test knowledge gain could be computed for 65 participants. A 2 x 2 ANOVA, with the factors 'Concept Explanations and 'Condensed Civil Code' only showed a significant main effect of 'Concept Explanations' on pre- to post-test knowledge gain, $F(1,61) = 56.01$, $MSE = 9.58$ $p < .001$, $f = .94$, indicating that students who had received the concept explanation during the learning phase ($M = 7.06$, $SD = 3.81$) scored better on the test than students who had not been given the explanations ($M = 1.25$, $SD = 2.11$).

Mental effort. A 2 x 2 ANOVA, with the factors 'Concept Explanations' and 'Condensed Civil Code' showed no significant differences in mental effort invested in any of the experimental phases (pre-test: all $F(3,64) < 1$; learning tasks: all $F(3,75) <1$; test task: all $F(3,75) < 1$; conceptual knowledge post-test: all $F(3,67) < 1$).

Time on task. A 2 x 2 ANOVA, with the factors 'Concept Explanations' and 'Condensed Civil Code' showed no significant differences (pre-test: all $F(3,64) < 1$; learning tasks: all $F(3,75) <1$; test task: all $F(3,75) < 1$; conceptual knowledge post-test: all $F(3,67) < 1$).

Table 1. Means and standard deviations of performance, mental effort, and time on task in experiment 1

	Concepts and Condensed Code		Concepts		Condensed Code		No support	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pre-test performance *max. 34*	9.50	3.46	7.68	1.95	9.24	3.65	8.38	3.54
Mental effort pre-test *max. 9*	5.42	.77	5.65	.933	5.40	1.13	5.05	1.47
Time on pre-test *sec.*	1014.95	635.40	625.90	218.22	871.70	487.94	1024.58	716.86
Mental effort training *max. 9*	5.45	1.33	5.90	1.12	5.68	1.41	5.71	1.40
Time on training phase *sec.*	780.85	247.23	1007.37	237.97	960.03	481.51	832.21	466.79
Performance test task *max. 100*	24.55	13.88	16.50	10.72	22.20	15.21	8.79	6.61
Mental effort test task *max. 9*	5.40	1.23	5.70	1.26	5.85	1.60	5.74	1.37
Time on test phase *sec.*	638.25	297.23	478.55	176.59	839.55	492.58	377.32	188.39
Post-test performance *max.34*	16.24	4.52	14.65	3.83	11.00	3.66	9.06	3.96
Mental effort post-test *max. 9*	4.89	1.24	5.30	1.08	5.21	1.13	5.41	1.28
Time on post-test *sec.*	498.85	269.48	519.65	201.21	579.10	293.69	505.26	280.55
Pre- post-test gain *max. 34*	6.57	3.63	7.42	3.99	1.82	2.33	.60	1.68

Discussion

This experiment investigated whether novice (first-year) law students' learning was enhanced by providing them with instructional support consisting of concept explanations, a condensed civil code, or both, while solving cases. Performance on a test case under normal conditions was improved when students made use of a condensed civil code (i.e., containing only those articles necessary in order to solve the case) during the learning phase. This finding suggests that reducing the required search space enables students to learn better. Rather than losing precious cognitive resources on searching through large amounts of information (i.e., ineffective cognitive load), students' attention can be entirely devoted to making sense of the relevant information in the code in relation to the case (i.e., effective cognitive load). Note that these students had to use the complete code (i.e., normal situation) on the test task. It seems that if students learn in what kind of situations (i.e., situations containing similar structural features) specific rules should be applied, their search process in a complete civil code becomes more efficient because they have learned what they should search for and where.

Providing students with concept explanations led to better knowledge of those concepts (higher pre- to post-test gain), which means that students in the concept explanations condition did attend to this type of support; they learned (i.e., were able to recall) the meaning of concepts. But apparently, this did not affect their performance on the test case, possibly, because deeper understanding of the underlying legal framework such as the implications of the rights and duties implied by concepts as 'gift', 'owner' and 'hire agreement', was not attained. This finding suggests that this form of support may be interesting for law education, as students' acquisition of conceptual knowledge can be enhanced by presenting concept definitions along with cases, but concept definitions are not sufficient to enhance students' learning to solve cases.

The results on perceived mental effort during the training and test tasks did not differ between the groups. However, it is important to regard mental effort data in light of performance data; the same amount of mental effort invested during training and test resulted in higher test performance in the condensed code condition, so the cognitive processes in which the effort was invested were more useful for learning and test performance in this condition than in the other conditions (Van Gog & Paas, 2008). In other words, the performance benefits that appeared on the test task, were obtained with the same amount of mental effort invested during the learning phase and during the test, indicating higher efficiency of this condition in terms of both the learning process and in terms of the quality of learning outcomes (see Van Gog & Paas, 2008, for a discussion of both types of efficiency).

These findings show that learning to solve cases with a condensed civil code leads to better performance under 'normal' conditions (i.e., in which the complete civil code has to be used). However, if we look at the average test performance scores in this group, it seems that there is still a lot of room for improvement. This may be because the interventions studied here were only focused on support at the con-

ceptual level and on the search process level, not on the reasoning process itself. Students may profit from a form of support that not only helps them to see *which* articles in the civil code are relevant to apply to a specific case, but also *why* those articles are relevant (i.e., what is the underlying legal framework) and *how* they can be applied, because argumentation plays an important role in reasoning about cases (cf. Deegan, 1995; Lundeberg, 1987). Good argumentation is not only necessary to persuade and convince others, but also to formulate a defence in such a way that there is no room left for others to rebut arguments. Therefore, experiment 2 focuses on support for the reasoning process.

Experiment 2

Reasoning can be supported in several ways, for example, by worked examples, flow charts, process-steps, or decision support systems. In well-structured domains, a number of effective instructional formats have been identified that fully or partially show *what* specific problem solving steps should be taken (and sometimes *how* or *why* these steps should be performed), such as worked examples (e.g., Sweller & Cooper, 1985), process-oriented worked examples (Van Gog, Paas, & Van Merriënboer, 2006, 2008) or completion problems (i.e., partially worked examples with blanks for the learner to complete; Paas, 1992). These formats prevent students' use of weak problem-solving strategies and lower the ineffective load on working memory, allowing them to direct all their cognitive resources towards studying and constructing a cognitive schema of a good problem solution. As such, these instructional formats are alternatives to 'learning by doing'. In the current experiment it is investigated whether the findings in less complex domains also apply to complex domains, such as law. We provided students with two different forms of support: process-steps and worked examples. The process-steps provided in this experiment provide students with a general set of steps to be taken in case solving. In this experiment, two student groups were included. Not only novices (first-year), but also advanced (third-year) students participated, for reasons we will explain below.

Process-Steps

Process-steps provided students with a set of generic steps to guide their reasoning about the case, derived from Toulmin's model of argument (Toulmin, Rieke, & Janik, 1984): *grounds, warrants, backings, rebuttals, qualifiers, and conclusion(s)*, which can be taken to structure arguments in such a way that important assumptions, evidence, and exceptions of a case can be made explicit. In solving a legal case, a lawyer must first distinguish and extract the legally relevant facts (*grounds*) from the case information. Based on the relevant facts, applicable sources of law referred to as *warrants* (e.g., rules of law and statutes) have to be identified, along with possible additional information like a reference to generally accepted knowledge, norms or court judgments, which can strengthen the warrant (i.e., *backings*). These *warrants*

and backings have to be compared to the grounds to test whether rules are indeed applicable to these facts. Applicable rules of law have to be placed in a specific sequence in which the more specific rules will be tested after the more general rules have proven valid. *Rebuttals* are information elements from the case that are exceptions on rules, and the *qualifier* reflects the probability of a legally correct conclusion on the basis of the available grounds, warrants, backings and rebuttals. The final *conclusion* (i.e., judgment) should be drawn, consisting of that which, based on available information, can be asserted.

In an experiment performed by Carr (2003), second year law students were either supported with Toulmin's argumentation process-steps or received no support at all while formulating arguments about cases. It was assumed that the group of students supported with those steps would formulate arguments of higher quality on a final exam. The results, however, showed no significant differences between the groups. These findings might indicate that Carr's second-year students did not yet have the necessary level of domain knowledge to formulate high quality arguments based on their prior knowledge and that, as a result, these process-steps are not a very effective type of support for them. Findings by Van Gog et al. (2006) also showed that for *novice* students, providing them only with a description of a systematic approach to problem solving did not improve their learning compared to problem solving without any support.

However, the effects of process-steps as a function of expertise have not yet been explored, and for students who have sufficient prior knowledge, process-steps might be an appropriate form of support.

Worked examples

In contrast to the general process-steps, worked examples present students with fully worked-out steps. A worked-example consists of descriptions of the initial problem formulation, the goal state, and the solution steps to be taken to reach the goal state -and in case of process-oriented examples, also information on *how* and *why* those steps were selected (Van Gog et al., 2006, 2008). Research has shown that for novices, learning by studying worked examples is more effective and efficient than learning by solving the same problems themselves (see for reviews Atkinson, Derry, Renkl, & Wortham, 2000; Renkl, 2005; Sweller et al., 1998). Sweller et al. attributed this to the fact that novices can only rely on generic problem-solving strategies such as means-ends analysis, which impose a high load on working memory and do not contribute to learning. By providing them with worked-out problem solutions to study, learners' attention can be fully devoted to building a schema for how the problem should be solved (i.e., learning). Worked examples can also enhance transfer, when learners not only learn to apply the demonstrated solution procedure, but also understand it, so that they are able to flexibly apply (parts of) it in solving novel problems (Mayer & Wittrock, 1996).

Worked examples have proven effective for schema acquisition in several domains, but it should be noted that these were primarily domains that are highly

structured such as mathematics (e.g., Gerjets, Scheiter, & Catrambone, 2006; Große & Renkl, 2006; Paas, 1992; Sweller & Cooper, 1985), geometry (e.g., Paas & Van Merriënboer, 1994; Schwonke, Renkl, Krieg, Wittwer, Aleven, & Salden, 2009), or physics (e.g., Reisslein, Atkinson, Seeling, & Reisslein, 2006; Van Gog et al., 2006, 2008). Few studies have addressed effects of worked examples in more ill-structured domains such as learning to recognize designer styles (Rourke & Sweller, 2009), learning to collaboratively diagnose a patient and design a treatment plan (Rummel & Spada, 2005), and learning argumentation skills (Schworm & Renkl, 2007).

Research using highly structured tasks, has shown that worked examples are not effective for all students. The phenomenon known as the 'expertise reversal effect' (Kalyuga, Ayres, Chandler, & Sweller, 2003) indicates that instruction consisting of studying worked examples improves novices' learning and transfer, but is ineffective for or can even hamper learning of advanced students who have prior knowledge of the task. Kalyuga et al. concluded that the information provided by worked examples can be redundant for advanced students, that means, once they have acquired a schema for solving that problem, studying a solution procedure is unnecessary and may even interfere with their own schema for solving that problem. However, Schmidt et al. (2007) suggested that findings concerning high levels of instructional guidance obtained in well-structured domains, might not necessarily apply to ill-structured domains. The studies by Rourke and Sweller (2009), Rummel and Spada (2005), and Schworm and Renkl (2007) suggest, however, that worked examples may also be effective with less structured tasks. In addition; the findings by Rourke and Sweller also suggested that in more complex domains, advanced students might still benefit from examples. This may also be the case in the legal domain, as the findings by Nievelstein et al. (in press, Chapter 3) suggested that even though third-year students performed much better than novices and could profit from the use of a civil code, they still had a lot of room for improvement. However, if the expertise reversal effect would apply, it may be counterproductive for advanced students to learn with fully worked examples, because the examples might interfere with their existing schemas, and as a result, might hamper learning (Kalyuga et al., 2003).

In sum, this experiment was designed to investigate whether novices' and advanced law students' reasoning about cases will improve when, during the learning phase, they are presented with *worked examples* to study rather than with the same cases to solve themselves, and/or with *process-steps* derived from Toulmin's model of argument (Toulmin et al., 1984) that describe a systematic generic approach to solving cases. It is hypothesized that novices would learn most if they were supported with worked examples (either with or without process-steps being made explicit as well) because they lack the necessary knowledge to solve cases, whereas advanced students might either also benefit from studying worked examples (cf. Rourke & Sweller, 2009), or, if the findings concerning the expertise reversal effect (Kalyuga et al., 2003) apply, then the process-steps, which provide more generic guidance, might be the best form of support for advanced students.

Method

Participants

Seventy-five first-year law students and 36 third-year law students from a Dutch university volunteered to participate in this study. All first-year students were novices on the topic of private law (i.e., they had not yet started with the introductory course on this topic). The third-year students had completed several courses on private law. For their participation, first-year students received a financial compensation of €10 and a small amount of course credit on a written exam. Third-year students received a financial compensation of €30.

Design

A 2 x 2 x 2 factorial design with the factors Worked Examples (Yes/No), Process-steps (Yes/No) and Student Expertise (Novice –first-year/Advanced –third-year) was used. As a result, at each student expertise level, there were four conditions: 'Worked Examples – Process-steps' (first-year, n = 19; third-year, n = 9), 'Problem Solving – Process-steps' (first-year, n = 19; third-year, n = 9), 'Worked Examples – No Process-steps' (first-year, n = 19; third-year, n = 9), and 'Problem Solving – No Process-steps' (first-year, n = 18; third-year, n = 9).

Materials

Electronic experimental environment. As in experiment 1.

Prior knowledge test. The pre-test used in experiment 1, was used as a prior knowledge test here that served the purpose to check whether random assignment was successful in ruling out prior knowledge differences between conditions and whether advanced students indeed had more prior knowledge than novices.

Learning tasks. The learning tasks were identical to those used in experiment 1; they consisted of two civil law cases at a level of difficulty appropriate for first-year students, with the same underlying theme (ownership and transfer of property) but different contexts. The learning tasks appeared in text on the computer screen. In the process-steps conditions, five generic steps (i.e., *grounds, warrants, backings, rebuttals and conclusion*) that should be taken to reason about a case according to Toulmin's Model of Argument (Toulmin et al., 1984) were listed in the instructional text above the case, and were presented in diagrammatic form beside the case. Participants received the instruction to substantiate the case according to those five steps. In the worked examples conditions, a worked-out step-by-step argumentation according to the steps of Toulmin's model was provided of the case, with the instruction to carefully study the worked examples and to try to understand why these problem solving solutions were applied to the case. In the process-steps and problem-solving condition (i.e., control condition), a typing window was presented in which students had to write their argumentation. There was no limitation on the

number of characters that could be typed in this window, and students could use the Dutch civil code.

In the combined condition, the process-steps were explicitly mentioned in the worked examples (whereas in the examples only condition, they were only implicitly present).

Test task. As in experiment 1.

Mental effort rating scale. As in experiment 1.

Procedure

Two-hour group sessions with maximally 20 participants per session (divided over different conditions) were scheduled in a computer room at the law school. In each session, participants were randomly assigned to conditions, by having the experiment leader randomly hand out login codes that ascribed participants to one of the four conditions. Participants first received a short oral explanation about the procedure. Then, they were instructed to log on to the electronic learning environment and follow the directions on the screen. They could work at their own pace. All participants first completed the pre-test. Then they received the two learning tasks either with or without process-steps and with or without a worked-out solution, depending on their assigned condition. After completing the learning tasks, they worked on the test task. Participants were allowed to use the civil code during the learning and test tasks. After each learning task and the test task, they rated their perceived amount of invested mental effort. After they had filled out the last mental effort rating scale, participants were automatically logged out of the system.

Data analysis

Performance on the prior knowledge test and the test case was determined as in experiment 1.

Results

Table 2 presents the means and standard deviations of the first-year students' performance scores, mental effort ratings, and time on task. Table 3 presents the same data for third-year students. For all analyses reported here, Cohen's *f* is provided as a measure of effect size with .10, .25, and .40, corresponding to small, medium, and large effects, respectively (Cohen, 1988).

Prior knowledge

An ANOVA showed that there were no differences between conditions in prior knowledge for the first-year students, $F(3,65) < 1$ (six participants were not included in this analysis because their prior knowledge test data were lost due to a server connection failure; i.e., 'Worked Examples – Process-steps' $n = 1$, 'Problem Solving –

Process-steps' n = 3, 'Worked Examples – No Process-steps' n = 1, and 'Problem Solving – No Process-steps' n = 1). Neither were there significant differences on prior knowledge between conditions for the third-year students, $F(3,30) < 1$ (data of two participants were not logged due to a server connection failure; i.e., 'Worked Examples – Process-steps' n = 1, 'Problem Solving – Process-steps' n = 1). However, as expected, a t-test showed that third-year students (M = 17,12, SD = 3,13) had significantly more prior knowledge than first-year students (M = 8,86, SD = 2,85), $t(101) = -13,39$, $p < .01$, Cohen's d = 2.75 (equal to f = 1.38).

Test performance

Time spent on the learning tasks differed significantly among the different conditions and will therefore be treated as covariate in this analysis. A 2 x 2 x 2 ANCOVA with factors: 'Worked Examples', 'Process-steps', and 'Student Expertise', on test task performance, with learning time as covariate, showed a significant main effect of 'Student Expertise' $F(1,102)$, MSE = 425.62, $p < .001$, f = .40, indicating that third-year students (M = 59.67, SD = 32.12) significantly outperformed first-year students (M = 34.76, SD = 31.64) on the test task. Also a significant main effect was found for 'Worked Examples' $F(1,102)$, MSE = 425.62, $p < .001$, f = .97, indicating that students supported with worked examples during the learning phase, performed significantly better on the test task (first-year: M = 58.63, SD = 27.73; third-year: M = 82.28, SD = 18.11) than students supported with process-steps (first-year: M = 10.24, SD = 6,93; third-year: M = 37.06, SD = 26.71). There was also a significant interaction effect of 'Worked Examples' and 'Process-steps', $F(1,102)$, MSE = 425.62, $p < .05$, f = .50, indicating that for both first-year- and third-year students, support by process-steps alone led to low performance whereas support by process-steps in combination with worked examples led to high performance.

Mental effort

A 2 x 2 x 2 ANCOVA with factors: 'Worked Examples', 'Process-steps', and 'Student Expertise' with learning time as covariate, on mental effort during the pre-test, showed that third-year students had to invest significantly less mental effort (M = 4.68, SD = 1.30) than first year students (M = 5.58, SD = 1.04), $F(1,102)$, MSE = 1.26, $p < .001$, f = .37, but there were no significant main effects of 'Worked Examples' $F(1,102) = .23$, $p > .20$, or 'Process-steps' $F(1,102) = 3.26$, p = .74, nor an interaction $F(1,102) = .30$, $p > .20$.

On the learning tasks, third-year students invested significantly less mental effort (M = 4.46, SD = 1.52) than first-year students (M = 5.75, SD = 1.41), $F(1,102)$, MSE = 1.88, $p < .001$, f = .44. A main effect of 'Worked Examples' on mental effort invested in the learning phase was found, indicating that students who studied worked examples had to invest less mental effort (first-year: M = 5.25, SD = 1.04; third-year: M = 4.08, SD = 1.06) in the learning tasks than students supported with process-steps (first-year: M = 6.27, SD = 1.55; third-year: M = 4.83, SD = 1.83), $F(1,102)$, MSE = 1.88, $p < .01$, f = .30.

On the test task, third-year students reported significantly less mental effort (M = 4.61, SD = 1.50) than first-year students (M = 5.88, SD = 1.47), $F(1,102)$, MSE = 2.25 p < .001, f = .43, but there were no significant main effects of 'Worked Examples' $F(1,102)$ = .05,p > .20, or 'Process-steps' $F(1,102)$ = 1.67, p > .20, nor an interaction $F(1,102)$ = 2.04, p > .2

Table 2. Means and standard deviations of first-year students' performance, mental effort, and time on task in experiment 2

	Examples and Process-steps		Examples		Process-steps		No support	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pre-test performance *max. = 34*	9.39	2.28	8.19	3.25	9.00	3.31	8.76	2.59
Mental effort pre-test *max. = 9*	5.42	.92	5.74	1.05	5.53	1.12	5.67	1.19
Time on pre-test *sec.*	868.00	484.07	929.21	643.13	918.79	723.38	736.94	453.679
Mental effort training *max. = 9*	5.34	1.11	5.16	1.00	6.66	1.65	5.86	1.37
Time on training phase *sec.*	589.37	256.27	547.58	200.18	1560.26	622.57	831.58	337.64
Performance test task *max. = 100*	59.58	31.42	57.68	24.34	9.53	6.42	11.00	7.54
Mental effort test task *max. = 9*	5.68	1.16	6.05	1.62	6.05	1.87	5.72	1.18
Time on test phase *sec.*	1717.16	724.00	1780.68	617.54	411.68	175.39	494.89	165.10

Comparative Analysis Experiment 1 and 2

Because the same learning and test tasks were used in experiment 1 and 2, and novice participants in both experiments were students from the same cohort, it is possible to compare the factor that led to the best test performance in experiment 1 (Condensed Code) with the factor that led to the best performance in experiment 2 (Worked Examples). A comparison of Tables 1 and 2 suggests that learning from worked examples is more effective than learning with a condensed civil code. A t-test confirmed this: studying worked examples led to significantly better performance, than support provided by the condensed civil code, $t(37)$ = -5.49, p < .01, d = 1.75. There were no significant differences on invested mental effort during learning, $t(37)$ = 1.32, p > .10 or on the test, $t(37)$ = -.39, p >.10.

Table 3. Means and standard deviations of third-year students' performance, mental effort, and time on task in experiment 2

	Examples and Process-steps		Examples		Process-steps		No support	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pre-test performance *max. = 34*	17.00	2.14	17.25	4.06	17.00	3.78	17.22	2.77
Mental effort pre-test *max. = 9*	4.78	1.12	5.22	1.09	4.00	1.50	5.00	1.23
Time on pre-test *sec.*	796.00	292.06	1078.78	399.19	964.78	396.66	1101.33	344.26
Mental effort training *max. = 9*	4.22	1.03	3.94	1.13	4.44	2.34	5.22	1.15
Time on training phase *sec.*	443.83	187.39	410.89	142.09	1101.33	364.40	849.83	334.99
Performance test task *max. = 100*	86.00	18.59	78.56	17.89	27.78	29.03	46.33	21.89
Mental effort test task *max. = 9*	4.44	1.33	4.67	1.50	4.22	1.92	5.11	1.27
Time on test phase *sec.*	1540.89	653.18	1956.56	573.30	628.56	365.69	659.33	194.839

Discussion

This second experiment investigated whether providing first- and third-year students with instructional support consisting of worked examples, process-steps, or both, during learning, led to better reasoning about this type of cases as measured by performance on a test task.

In line with our hypothesis, first-year students performed best on the test case when they had studied worked examples during the learning phase. Moreover, despite their higher level of expertise as corroborated by their higher prior knowledge scores, learning task performance (i.e., in the problem-solving conditions), higher test performance, and their lower mental effort ratings, the same applied to third-year students. The finding that studying worked examples leads to better test performance than process-steps or problem solving with less mental effort invested during learning, replicates that of other studies (e.g., Paas & Van Merriënboer, 1994; Van Gog et al., 2006), but in contrast to some other studies we found no differences between conditions in mental effort invested during the test task (e.g., Paas, 1992; Paas & Van Merriënboer, 1994). Nonetheless, these findings indicate that studying worked examples was more efficient in terms of the learning process (higher test performance with lower investment of effort during learning) and in terms of the quality of learning outcomes (higher test performance with equal investment of effort in the test; see Van Gog & Paas, 2008).

Providing students only with process-steps to be taken, did not improve their learning. On the contrary, it had disadvantageous effects on performance when only the steps were given (i.e., not combined with a worked example). This suggests that this is not an effective way of providing guidance. A possible explanation is that the process-steps interfere with learning because students try to use them but are not able to do so effectively because they need to find out for themselves what they have to do at those steps and why.

General discussion

The experiments presented here investigated the effects of different types of instructional support on acquisition of a complex cognitive skill: learning to solve legal cases. This skill plays a pivotal role in the legal profession, and regardless of whether a law school's curriculum is more focused on formal lectures, tutorials, group collaboration, self-study, or a combination of those, students usually are taught to reason about cases in a 'learning by doing' manner, that is, by engaging in reasoning about many cases with the aid of law books and/or court judgments. Research suggested that this is not the most optimal way of teaching this skill (e.g., Nievelstein et al., in press, Chapter 3), and that students, especially novices, might need higher levels of instructional support.

Experiment 1 showed that students' performance improved when they were supported with a condensed civil code. Using a condensed code reduces the amount of search and the need to keep the case information that inspired the search in mind. It also reduces the need to have knowledge about how such codes are organized, that is, knowledge about where information can be found. Thus, a condensed code presumably reduced ineffective load on working memory, and as a consequence, students could devote more cognitive resources to understanding the information presented in the code and linking this information to the case, than students who had to use the complete civil code. On the test case, all students had to use the complete code, which posed no problems for the students who learned with the condensed code, presumably because they had learned which articles could be applied to the same kind of problem, and were therefore able to conduct a more directed search for the relevant articles in the complete code. Although it led to higher conceptual knowledge gain, there was no effect of providing concept explanations on reasoning performance, possibly because the meaning of each single concept was given without any further information about the relationship(s) with other concepts and its implication(s) in this specific context. An interesting question for future studies would be to investigate whether a concept map that also shows the significant relationship(s) between those concepts would be more effective than a list of concepts.

Experiment 2 showed that both first-year students' and third-year students' performance improved when they learned by studying worked examples. From these results, it can be concluded that instructional formats that provide more sup-

port or guidance are also effective in more complex domains (cf. Rourke & Sweller, 2009) and that the suggestion by Schmidt et al. (2007), that findings on instructional support on structured tasks might not necessarily apply to more complex tasks, seems to be incorrect. Our data even suggest that in complex domains, instructional support remains valuable even for advanced students. In a way, this makes sense, because when a domain is ill-structured, it becomes harder or may take longer to reach an expert level (cf. Custers et al., 1998). That is, tasks in complex domains are characterized by a high number of non-recurrent (or non-routine) task aspects (Van Merriënboer & Kirschner, 2007), and acquiring expertise in such domains requires not only obtaining experience in a high number of different contexts but also processes of verifying, integrating, and changing knowledge, to build rich knowledge bases. In more structured domains, tasks contain more recurrent (routine) elements, which, once learned, can be applied similarly across tasks, and therefore, expertise can be developed faster.

A comparison of the Condensed Civil Code (without Concept Explanations) and the Worked Example (without Process-steps) conditions from experiments 1 and 2 showed that a high level of instructional support consisting of studying worked examples was more effective than the use of a condensed civil code. This is probably a result of the fact that worked examples provide the most comprehensive type of support for learning to reason about cases.

In interpreting these findings, it should be noted that the experiments presented here also have some limitations. First of all, the support types were studied in an experimental session of relatively short duration in which students were trained with only two successive cases on a single underlying legal framework. Therefore, it remains unclear whether these support types remain effective after a delay, whether they are viable in courses of longer duration, and whether transfer of learning might occur to cases with different underlying frameworks. Secondly, these experiments were conducted in Civil (European-Continental) law where documented laws are the primary sources of jurisdiction, and reasoning is mainly rule-based. This means the findings presented here may not necessarily apply in Common (Anglo-Saxon) law, where documented court judgments are the primary sources of jurisdiction and reasoning is more case-based (by analogy). However, despite these differences, the underlying reasons for why the support is effective might not be that different (e.g., searching through databases with jurisdiction may also impose a high cognitive load when little knowledge is available of how it is organized or how to interpret the information found) and similar types of support might also be effective in Common law.

Despite these limitations, these experiments may have some interesting theoretical and practical implications, and suggest interesting directions for future research. As discussed above, these findings support the notion that instructional support is also effective in complex domains, and our second experiment even suggests that an expertise reversal effect may not occur -or at least not as rapidly- in complex domains. Implementing a heavier reliance on worked examples in curricula may be interesting for law educators, because it not only leads to better learning

outcomes, but may also have the effect that the learning trajectory becomes more efficient. Not only in the cognitive sense already discussed (i.e., in terms of students' required effort investment), but also in the sense that education that is better tailored to learners' needs, may require less time (cf. Zhu & Simon, 1987), thereby allowing learners to progress faster and/or leaving time for deeper elaboration of topics. In implementing a heavier reliance on worked examples in the curriculum though, it is important to note that research in highly structured domains has shown that instructional support needs to be high initially and should then be gradually decreased, or faded out (e.g., by providing students with completion problems, that is, partly worked examples with an increasing number of blanks for the student to complete; Paas 1992), followed by solving problems without any support in the end (see Renkl & Atkinson, 2003). There is no reason to assume that this completion or fading strategy would not apply in more complex (i.e., less structured) domains, but the findings of the second experiment suggest that the dynamics (e.g., timing) of this fading principle may be different in more complex domains such as law, which is an interesting question for future research.

Addendum

Worked examples implemented in a law course

The experiments described in Chapter 4 show the promise of instructional support for ameliorating the difficulties students experience in learning to reason about cases. However, experiments are highly controlled and of short duration, and an important question is whether these effects can also be found in more ecologically valid settings. The following field study suggests they do.

In 2008, the Faculty of Law at Tilburg University implemented worked examples in a four-week course on property law taught to first-year students (novices). Contrary to the method used in the foregoing years in which students had to solve one case every week that was elaborately discussed during the tutorial, their practice was now divided into three phases. Every course week, students were obliged to study a worked example of a case with a particular underlying legal framework in an electronic learning environment. After studying the case, the students had to solve a case with the same underlying legal structure as the worked example themselves. The solution of that case was given during the weekly tutorial meeting in which a law teacher discussed the content and the steps towards the solution with the students. In total, 392 students attended the official examination, comparable to the number of students in foregoing years. The examination consisted of four parts. In the first part, students had to solve a case that had the same underlying structure as one worked example that had been studied during the tutorial (retention). In the second part, students again had to solve a case, but here students had to combine and integrate several different aspects they had studied separately by means of several worked examples -but not in combination with each other- during tutorials (transfer). The third and the fourth part required knowledge reproduction of theory literally mentioned in books and formal lectures. In total, 51% of the students passed the official exam (i.e., 200 students). The percentage of students who passed a similar official exam on property law in 2007, was 35%. Four weeks after the official examination, students who failed could try again (a re-examination) and 97 students (about 30 students less compared to foregoing years, which is logical considering the higher success rate on the initial exam) attended this re-examination, and 36% of them passed, compared to 26% the year before.

Of course, these results have to be interpreted with care, as it cannot be ruled out based on the available data that this cohort was not in other ways different from the previous year, but nonetheless, it seems that worked examples are an effective way of enhancing learning when applied in law curricula.

5
General discussion

Parts of this Chapter are based on:
Nievelstein, F., Van Gog, T., & Prins, F. J. (2008). Instructional models in domains and professions - Learning law: The problems with ontology and reasoning. In J. M. Spector, M. D. Merrill, J. J. G. Van Merriënboer, & M. P. Driscoll (Eds.), *Handbook of Research on Educational Communications and Technology* (3rd rev. ed., pp. 552-556). New York: Erlbaum/Routledge.
Nievelstein, F., Van Gog, T., Van Dijck, G., Spoormans, H., & Boshuizen, H. P. A. (2009). *Expertise development in law: How instruction can be supported*. Manuscript submitted for publication.

In this final chapter, the main findings of the studies reported in this dissertation are summarized and discussed in terms of conclusions and theoretical implications. In addition, practical implications and directions for future research are discussed.

Discussion of main findings

Learning to reason about cases implies constructing cognitive schemas that incorporate the knowledge and skills required to guide future solving of cases. The general process of reasoning about cases consists of a) determining the underlying legal framework, b) identifying applicable laws, rules, and court judgments, c) searching for counterexamples, and d) substantiating arguments convincingly (cf. Blasi, 1995). However, the current way of teaching students how to solve legal cases (i.e., by having them solve lots of cases) does not optimally contribute to schema development[4]

The main aim of this dissertation was to gain insight in the kind of difficulties students with different levels of expertise encounter when they learn to reason about cases, as well as to investigate the effects of different kinds of instructional support on reasoning performance. Chapter 1 presented data from an interview conducted with law students and teachers, which showed that learning to reason about law cases entails several difficulties for students. The difficulties students experience can be mainly related to characteristics of this complex domain, which make it difficult to acquire expertise in legal reasoning: acquisition of conceptual knowledge and ontology, the use of external sources, and adversarial reasoning. With regard to conceptual knowledge and ontology, the findings from Chapter 2 show that students -not surprisingly, especially novice students- lack correct conceptual knowledge, which is also characterized by the fact that they mainly use everyday language to describe concepts. Moreover, there were large differences among students, showing a lack of ontology (i.e., shared and agreed upon explicit meaning). In addition, it was found that increasing expertise is characterized by the ability to activate different schemas with regard to intermediate concepts (i.e., *owner*). Such concepts that do not have one single, fixed meaning but their function varies depending on the context (Lindahl, 2004; Vranken, 2006). Not only experts, but also advanced students were more accurate than novices in their elaborations of such a concept. These findings are important, because conceptual and ontological knowledge is necessary for correct classification of problems and tasks, as well as for communication and argumentation in the domain .

With regard to the use of external information sources, Chapter 3 showed that the normal way of practice, that is, with the availability of a civil code, had positive effects on reasoning only for advanced students, but not for novice students. These results demonstrate that conceptual knowledge and knowledge of external sources

[4] This does not mean that students do not learn at all from engaging in solving many cases, just that they do not learn as much as quickly as they might with other kinds of practice.

are important for solving cases. Interestingly, it was also found that without the availability of the code, experts' performance on reasoning about a case that should have been relatively easy for them, was rather low. In this respect, the legal domain seems to differ from other domains such as medicine or engineering, because professionals always need to refer to external information sources, not only to substantiate conclusions, but also for working towards conclusions by identifying specific rules and/or court judgments. The possibility to consult external sources at any time prevents them from the need to learn the endless number of rules, court judgments, and counterexamples by heart, which is not only time consuming, but also almost impossible to do.

Building on the findings from Chapters 2 and 3 regarding students' conceptual knowledge and use of the civil code, the first experiment presented in Chapter 4 investigated the effects on learning of providing students with additional support, by giving them concept explanations along the case, a condensed civil code containing only relevant articles rather than the entire code, or both. Students who had received the concept explanations did not perform better on reasoning about a test case. They did, however, gain conceptual knowledge. The condensed civil code did positively affect novices' performance on reasoning about the test case. Nonetheless, there was still a lot of room for improvement, presumably because concept explanations and condensed codes alleviate difficulties experienced by students, but they do not support the entire reasoning process. The second experiment in Chapter 4 investigated two interventions that were assumed to support the reasoning process, by means of process-steps, worked examples, or both. Studying worked examples substantially increased performance on the test case for both novices and advanced students. It seems that schema development is effectively supported by providing students with examples to study that show elaborations on the meaning and implication of concepts -especially intermediate concepts-, for the use of external sources and the reasoning process itself. As the Addendum to Chapter 4 shows, positive effects of studying worked examples on students' reasoning were also found in a real first-year law school course on property law.

The finding that worked examples were also effective for advanced students, has interesting theoretical implications. The effects of instructional support and guidance have thus far mainly been studied in more structured domains, in which it has been found that an expertise reversal effect occurs once students have some prior knowledge of a task, meaning that for instance, worked examples are effective for novices' learning compared to problem solving, but they lose their effectiveness once students have some prior knowledge, in which case problem solving becomes more effective (see Kalyuga, Ayres, Chandler, & Sweller, 2003). The advanced students in this study did have more prior knowledge than the novice students, and outperformed them. Nonetheless, the advanced students still benefitted from studying worked examples, which suggests that the interaction between instructional support and students' level of expertise is different in complex domains. This may also have consequences for instructional strategies based on the expertise reversal effect, such as a completion or fading strategy (see Renkl & Atkinson, 2003), in

which the amount of instructional support is gradually decreased (see the next section on 'practical implications' for a more detailed discussion).

Practical implications

The findings from the interview reported in Chapter 1, combined with the findings from the studies in Chapters 2, 3, and 4, suggest that law teachers are well advised to not rely as heavily on 'learning by doing', but rather provide students with more instructional support. One prevalent misconception among educators is that 'learning by doing' best prepares students for real practical, authentic situations. However, it is important to take into account students' expertise level when designing *learning* tasks. One cannot expect novice students to perform well in authentic, real life situations, because they have not yet acquired the skill to do so. Moreover, it can be questioned to what extent 'learning by doing' really resembles actual practical situations, in which there can be a hectic atmosphere at some moments, the pressure of deadlines, interaction with real (and sometimes stressed, or frustrated) clients, and where case judgments have actual personal or financial consequences. These circumstances are not practiced via the kind of 'learning by doing' implemented in law schools. Gaining expertise on those important skills, requires actual experience in the field in which students need to see many different cases under different circumstances (Sullivan et al., 2007; Vranken, 2006). How students can best learn to perform a task and how that task is performed in practice are two different things, and the studies discussed here show that more support is beneficial for learning.

The experiments in Chapter 4 showed first of all that adding concept explanations did help students to learn the meaning of concepts. Even though this did not affect their reasoning performance within the time-course of this experiment, students might acquire conceptual knowledge faster if they receive annotated cases that contain concept explanations in law school. Second, novices' reasoning did improve from using a condensed civil code, which is again, a relatively simple manipulation that could be implemented in educational practice. Third, providing students with process-steps was *not* effective for learning. It seems that providing students with only the steps they should take, does not help much, because they should still find out what to do exactly (see also findings by Muntjewerff, 2001). Finally, of the four types of instructional support studied in this dissertation, worked examples led to the highest learning gains. The field study described in the addendum to Chapter 4 suggests that a heavier reliance on studying worked examples can be successfully implemented in law school curricula. According to faculty members involved in this field study, the students were very positive about the worked examples. They said the examples helped them because the underlying framework was made clear and they felt they understood better why certain steps should be taken in a certain context.

A heavier reliance on studying worked examples in law school courses might lead to higher efficiency, not only for students, in the sense that better performance

is obtained with equal or less mental effort investment than through solving cases without further support (Paas & Van Merriënboer, 1993; Van Gog & Paas, 2008), but also for teachers, in the sense that education with a heavier reliance on examples is better tailored to learners' needs and may therefore require less time (cf. Zhu & Simon, 1987), thereby allowing learners to progress faster and/or leaving time for deeper elaboration of topics. In implementing a heavier reliance on worked examples in the curriculum though, it is important to note that research in highly structured domains has shown that instructional support needs to be high initially and should then be gradually decreased, or faded out (e.g., by providing students with completion problems, that is, partly worked examples with an increasing number of blanks for the student to complete; Paas 1992), followed by solving problems without any support in the end (see e.g., Atkinson, Renkl, & Merrill, 2003; Renkl & Atkinson, 2003). There is no reason to assume that this so-called completion or fading strategy would not apply in more complex domains, but the findings of the second experiment described in Chapter 4 suggest that the dynamics (e.g., timing) of this fading principle may be different in more complex domains such as law, because schema construction becomes harder or may take longer in complex domains as it requires the integration of different kinds of knowledge and skills (cf. Ericsson, 2006). This would be interesting to investigate in future experimental or practical research, along with several other questions discussed in the next section.

Future research

The studies reported in Chapter 4 are promising first steps towards alternative instructional formats that help alleviate the difficulties law students' experience in acquiring legal reasoning skills. However, a number of questions also remain for future research on law education.

First of all, the results from Chapter 2 suggest it might be interesting to look into the efficiency of teacher-student and student-student communication processes. Lack of overlapping knowledge (ontology) might complicate communication between students, which could be a problem in a collaborative learning setting, and differences in ontology might complicate communication between experts (teachers and professionals) and students. For example, research on expert-laypeople communication has shown that experts often experience difficulties with accurately estimating novices' level of knowledge, and adapting their explanations to that level (Bromme, Rambow, & Nückles, 2001; Nückles, Wittwer, & Renkl, 2005). Although law teachers should be trained in recognizing students' knowledge level and adapting to that, university teachers in particular are also domain experts. The teacher-student communication process might benefit from providing teachers with tools to accurately assess the level of conceptual knowledge development of their students may (cf. Bromme et al., 2001; Nückles et al., 2005).

Secondly, the studies described in Chapter 4 addressed the effects of instructional formats with higher degrees of support mainly in a self-study context (or

combined with a lecture after studying the example, as in the field study). Future research might focus on instructional formats that provide more support or guidance to students in other educational settings, such as in lectures or tutorials (e.g., a teacher or tutor working out an example) or in collaborative learning settings. Other variables may come into play under such conditions that may affect learning outcomes compared to self-study conditions. For example, motivation or pacing may become an issue when a teacher works out an example (e.g., the pace of a teacher working out an example during a lecture may be too fast or too slow for students to follow along), and group learning requires coordination processes that impose an additional cognitive load which may or may not be effective for learning (cf. Kirschner, Paas, & Kirschner, 2009).

Third, in contrast to the techniques applied in the studies in Chapters 2 and 3, the studies in Chapter 4 relied mainly on performance and cognitive load measures to draw conclusions about differences in acquired cognitive schemas. It might be interesting to use process-tracing techniques such as verbal reporting (Ericsson & Simon, 1993), concept mapping (Kane & Trochim, 2006), or eye-tracking (Duchowski, 2003), either alone or in combination, to explore in more detail how the content or structure of the schemas students have acquired in response to different types of support differs, as well as how they use these schemas in reasoning about new tasks. Uncovering such information could also lead to the development of other or more refined types of instructional support, and sometimes these techniques themselves may even be applied as a kind of instructional support (see Van Gog, Kester, Nievelstein, Giesbers, & Paas, 2009). For example, concept mapping might assist students in learning to understand the different functions of intermediate concepts (cf. science education: Roth, 1990; Van Boxtel, Van der Linden & Kanselaar, 2000).

Fourth, only four possible types of instructional support were investigated in this dissertation, all focussing on reasoning about a case in private law. Other types of support and support for other types of tasks in the legal domain are possible. For example, Hummel, Nadolski, and colleagues studied the effectiveness of presenting students with process worksheets during (specific phases of) learning how to prepare a plea (Hummel, Paas, & Koper, 2004; Nadolski, Kirschner, & Van Merriënboer, 2005). The process worksheets divided the problem of how to prepare a plea in several steps and guided the students by questions at each step. Both studies suggested that process worksheets may have beneficial effects on learning how to prepare a plea. The findings by Nadolski et al. suggested, however, that the number of steps in which the process worksheet is divided may play a crucial role. Too few steps may hardly provide any guidance at all and result in cognitive overload, whereas too many steps may lead to redundancy. In their study, an intermediate number of steps proved best, however, this benefit applied only to the learning process, not to learning outcomes. They did not, however, study a possible interaction with students' expertise levels.

Fifth, the types of support that were investigated here did not explicitly focus on one of the difficulties identified in Chapter 1, that is, adversarial reasoning. This

did implicitly play a role in the worked examples, but was not explicitly addressed. Future research could, for instance, study another type of worked examples explicitly directed at conveying adversarial reasoning skills by working out different perspectives -and as a logical result- the different implications of those perspectives on the same case. (cf. Chi, Roy, & Hausmann, 2008, who showed students examples of another student being tutored, which had a positive effect on students who observed the examples, i.e., without them being tutored themselves). By means of such examples, the steps taken by someone with role A and the possible (counter)arguments on those steps by someone with role B can be made explicit by providing information on *what* (counter)arguments can be made, and *how* and *why* these are good or bad arguments or can be rebutted. Another viable line of research on instructional support for adversarial reasoning would be to continue and extend the work by Ashley and Aleven (1991) on cognitive tutors that pose questions such as 'identify and assess possible counterexamples to rebut', monitor students' solution steps and provide feedback to support students with formulating more persuasive arguments.

Finally, the studies reviewed here were conducted in a Civil law context. Even though there is no reason to assume that heavier reliance on for instance worked examples or condensed information sources would not be effective in Common law as well, the systems do rely on different types of reasoning, and the information sources used in Common law are different. Even though the role of conceptual knowledge and the ineffectiveness of search processes when using these other information sources may not be that different in Common law, it would be interesting to investigate whether or not different kinds of support yield similar effects in that context.

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Summary

One of the main aims of law education in both the Civil (European-Continental) law and Common (Anglo-Saxon) law systems is to teach students to reason about cases. As reviewed in Chapter 1, students experience serious difficulties in learning to reason about cases, which seem to arise from the complexity of the domain, the way in which knowledge is acquired in complex domains, as well as the instructional approach widely used in law schools. This approach often consists of 'learning by doing', which means that students have to reason about lots of cases throughout their study by using information sources that professionals also use. The studies presented in Chapters 2 to 4 were designed to gain more insight in the kind of difficulties and the underlying causes that students with differing levels of expertise have when they learn to reason about cases in law school, as well as to investigate the requirements for effective instructional approaches that provide more support and might help to diminish or overcome the experienced difficulties.

Chapter 2 describes a study in which conceptual knowledge and ontological knowledge of 24 first-year students (novices), 24 third-year students (advanced), and 12 law faculty (experts) specializing in private law in the Civil law system was investigated, using a card-sorting task and a concept-elaboration task. The card sorting task consisted of 30different concepts, printed on separate cards, that were all in some way related to one main concept in private law: 'tort'. Participants were instructed to group the 30 concepts in such a way that the concepts in one group had stronger relations with each other than with concepts in other groups. While doing so, they had to verbalize aloud why they put specific concepts together and how these concepts were related to each other. The concept-elaboration task consisted of three central concepts (i.e., strict liability, damages, tort/unlawful act), one abstract concept (protective norm), and one intermediate concept (owner), selected from the concepts in the card-sorting task. Participants received the five concepts one by one in random order and were instructed to verbalize everything they knew about that specific concept, in a fixed time of two minutes per concept. It was hypothesized that 1) as expertise increases, knowledge would be more hierarchically structured and would show more overlap with individuals of the same level of expertise, 2) more central concepts would be provided in the card sorting task as expertise increases, 3) novices would order concepts randomly (without any structure) more often than advanced students and experts, 4) concept elaborations would be more accurate as expertise increases (which implies a higher degree of overlapping knowledge and agreed upon explicit representations, i.e., ontology), and 5) novices would give more daily examples in their elaborations than advanced stu-

dents and experts. Results on the concept elaboration task showed that novices indeed used more everyday language and were less accurate in their elaborations of concepts than advanced students and experts, and results on the card-sorting task showed that the organisation of their knowledge was very diverse within their group (i.e., lack of ontology). The organization of advanced students' knowledge partially overlapped within their group, but parts of their knowledge were still diverse. The organization of experts' knowledge, on the other hand, was strongly overlapping within their group (i.e., strong ontology) and was structured along different fields of law. Also in line with our hypothesis, experts mentioned more central concepts than both novices and advanced students by the card sorting task. Furthermore, they were more accurate than novices and advanced students in their elaborations of the five different concepts during the concept elaboration task.

Chapter 3 describes a study in which again 24 first-year (novices) and 24 third-year (advanced) student and 12 staff members specialized in private law (experts), participated. This study, investigated the role of conceptual knowledge in solving legal cases. First, a situation was studied in which no information sources could be used while reasoning about a case. It was predicted that: 1) students -novice and advanced- would be less accurate in solving a legal case than experts, and 2) that there would be differences in the problem-solving process because students have less conceptual knowledge than experts. This involved half of the first-year students, half of the third-year students, and all staff members. They were instructed to solve a case *without* the use of external information sources that would normally be at their disposal (in this case, the Dutch civil code), and to think aloud while doing so. Under these circumstances, first-year, and third-year students' performance was significantly lower than that of experts as expected, but even experts' performance was rather low. These findings suggested that experts not only relied on the code for substantiating conclusions, but also for working towards conclusions. Contrary to our expectations, no differences between experts on the one side and first-year and third-year students on the other side were found with regard to problem-solving processes. The fact that experts and students did not differ with regard to their problem solving process, might be a consequence of not being allowed to use information sources which may have interfered with their usual approach to problem solving. Second, it was studied whether first-year students and third-year students would actually benefit from the availability of the civil code when they have to solve a legal case, and it was hypothesized that this might not be the case for novices, because their lack of conceptual knowledge would also affect the use of the civil code. Performance of twelve fist-year students and twelve third-year student who *were allowed* to use the civil code when solving the case while thinking aloud was compared to the performance of the previously mentioned twelve first-year and twelve third-year students who were *not* allowed to use the civil code when solving the case. In line with our expectation, it was found that having the civil code available did not improve first-year students' performance, while third-year students did better with the code. Not being able to profit from the availability of the

code is very likely a consequence of novices' lack of conceptual knowledge, lack of knowledge of how this information source is organized, or both.

Chapter 4 describes two experiments that investigated the effects of two different types of hypothesized support for learning to reason about cases. In the first experiment, seventy-nine first-year (novice) law students participated, and the effects of two types of instructional support on performance were investigated in a 2 x 2 factorial design: a) support for their lack of conceptual knowledge by providing them the meaning of the important case concepts along the case, which would help students to make more sense of the information in the case, and b) reducing their search process in the external source by providing a condensed (relevant articles only) rather than a complete civil code, which would reduce the high load imposed by the search process that is ineffective for learning to solve the case. Students were randomly assigned to one of the four conditions. They first completed a pre-test in which they had to provide the definitions of 20 relevant concepts, then studied two learning cases with the kind of support depending on the assigned condition, then solved a test case with no support provided (but they could use the standard complete civil code), and finally completed the conceptual knowledge test (cf. pre-test) again. It was found that test case performance, was significantly improved by use of the condensed civil code, but not by providing students concept explanations. This finding suggests that the ineffective load imposed by the search process is the most likely explanation for the difficulties novice students experience when learning to reason about cases. Although it did not affect reasoning, providing students with concept explanations along the case, was useful: it led to better reproduction of the formal meaning of those concepts after the learning phase compared to students who had not received the explanations. Presumably, this was not sufficient to foster reasoning because the meaning of each single concept was given without any further information about the relationship(s) with other concepts and its implication(s) in this specific context. In all conditions, however, there was still a lot of room for improvement on test case performance. The second experiment investigated support for the entire reasoning process.

In this experiment, 75 first-year students and 36 third-year students participated, and the effects of two different types of support were investigated for students at different levels of expertise (i.e., a 2 x 2 x 2 factorial design): a) process-steps provided students with a set of generic steps to guide their reasoning about the case, b) worked-examples provided students with a worked-out ideal solution of the cases -initial problem formulation, goal state, and solution steps- to study. Within each expertise level, students were randomly assigned to one of the four conditions. After completing the pre-test (the same as in experiment 1), they studied two learning cases (the same as in experiment 1) with the kind of support depending on the assigned condition, and then solved a test case (the same as in experiment 1) with no support provided (but they could use the standard complete civil code). It was predicted that a) novices would learn most if they were supported with worked examples (either with or without process-steps being made explicit as well) because they lack the necessary knowledge to solve cases, whereas, b) advanced students

might either also benefit from worked examples, or if the findings concerning the expertise reversal effect (found in highly structured domains; Kalyuga, Ayres, Chandler, & Sweller, 2003) apply also in more complex domains, then the process-steps, which provide more generic guidance, might be the best form of support for advanced students. The results showed that test performance improved significantly after studying worked examples during the learning phase, for both first-year and third-year students. Providing students with the process-steps to be taken, did not improve their learning, on the contrary: it had disadvantageous effects on performance of both groups of students when only the steps were given (i.e., not combined with an example). A possible explanation is that the process-steps interfere with learning because students try to use them, but are not able to do so effectively because they need to find out for themselves what they have to do at those steps and why.

The addendum to Chapter 4 described a field study in which a Faculty of Law implemented worked examples in a four-week first-year course on property law. The students had to study worked examples before the weekly tutorial. During the tutorial the teacher discussed the learned example with the students. Comparing the examination scores with the foregoing year in which worked-examples were not used, showed positive results (more students passed). Of course, these results have to be interpreted with care, as it cannot be ruled out based on the available data that this cohort was not in other ways different from the previous year, but nonetheless, it seems that worked examples are an effective way of enhancing learning when applied in law curricula.

Finally, Chapter 5 discusses the main findings in terms of theoretical and practical implications, as well as suggestions for future research.

Samenvatting

Het belangrijkste doel van het juridisch onderwijs in zowel het continentaal Europese als in het Angelsaksische rechtssysteem, is dat studenten leren redeneren over juridische problemen, ook wel casus genaamd. Zoals in Hoofdstuk 1 wordt beschreven, hebben rechtenstudenten aanzienlijke moeite met het leren redeneren over juridische casus. De moeilijkheden die studenten ervaren, lijken gerelateerd aan de complexiteit van het domein, aan de wijze waarop kennis verworven wordt in complexe domeinen, alsmede aan de wijze waarop het juridisch onderwijs wordt vormgegeven. Meestal is leren redeneren over casus gebaseerd op het principe 'leren door te doen', wat betekent dat studenten moeten redeneren over heel veel casus gedurende hun opleiding, gebruik makend van externe bronnen zoals wetboeken en naslagwerken over jurisprudentie die normaliter ook in de juridische praktijk worden geraadpleegd. De studies die worden beschreven in de hoofdstukken 2 tot en met 4 zijn opgezet om meer inzicht te krijgen in de aard van de moeilijkheden -en de onderliggende oorzaak daarvan- die studenten met verschillende expertiseniveaus ervaren wanneer zij leren redeneren over casus. Voorts wordt onderzocht aan welke eisen een effectieve onderwijsmethode zou moeten voldoen die erop gericht is de moeilijkheden die studenten nu ervaren te verminderen of weg te nemen door hen meer ondersteuning te bieden tijdens hun leerproces.

Hoofdstuk 2 beschrijft een studie waarin conceptuele kennis en ontologische kennis van 24 eerstejaarsstudenten (novieten), 24 derdejaarsstudenten (gevorderden), en 12 docenten van verschillende Nederlandse universiteiten gespecialiseerd in het privaatrecht (experts), werd onderzocht middels een kaartsorteertaak en een conceptuitlegtaak. De kaartsorteertaak bestond uit 30 verschillende concepten, afgedrukt op aparte kaartjes, die allemaal in meerdere of mindere mate gerelateerd waren aan een centraal concept binnen het privaatrecht: 'onrechtmatige daad'. Deelnemers kregen de opdracht om de 30 concepten te groeperen zodat concepten ondergebracht in één bepaalde groep een sterkere relatie met elkaar hadden dan met concepten die in andere groepen werden ondergebracht. Tijdens deze taak moesten deelnemers hardop denkend beargumenteren waarom zij specifieke concepten met elkaar in verband brachten. De conceptuitlegtaak bestond uit een selectie van concepten uit de kaartsorteertaak: drie centrale concepten: (d.w.z., risicoaansprakelijkheid, schadevergoeding, onrechtmatige daad), een abstract concept (d.w.z., relativiteitsbeginsel), en een contextgebonden concept (d.w.z., eigenaar). De deelnemers ontvingen de vijf concepten achtereenvolgens in een willekeurige volgorde. Zij kregen de instructie om alles dat zij wisten over het specifieke concept

hardop denkend uit te spreken gedurende twee minuten. De volgende hypothesen werden gesteld: 1) naarmate expertise toeneemt zal kennis meer hiërarchisch gestructureerd worden en zal er meer overlap in kennis zijn tussen deelnemers met een overeenkomstig expertiseniveau, 2) naarmate expertise toeneemt zullen deelnemers meer centrale concepten benoemen tijdens de structurering van de kaartsorteertaak, 3) novieten zullen, vaker dan gevorderde studenten en experts, concepten geheel willekeurig -zonder enkele structuur- ordenen, 4) naarmate expertise toeneemt zal de conceptuitleg meer accuraat zijn. Dit impliceert een hogere mate van overlappende kennis en het hebben van gemeenschappelijke expliciete externe representaties, d.w.z. ontologie, en 5) novieten zullen, vaker dan gevorderde studenten en experts, meer alledaagse voorbeelden geven bij de conceptuitlegtaak. Zoals verwacht lieten de resultaten van de conceptuitlegtaak zien dat novieten meer alledaags taalgebruik hanteerden en minder accuraat waren in hun conceptuitleg dan gevorderde studenten en experts. Daarnaast ondersteunden de resultaten van de kaartsorteertaak de assumptie dat de kennisorganisatie van novieten binnen hun eigen groep zeer divers was (d.w.z., geen ontologie). De kennisorganisatie van gevorderde studenten overlapte gedeeltelijk -met name met betrekking tot de oorzaken en consequenties van de onrechtmatige daad- binnen hun groep, echter, andere gedeelten van hun kennis overlapten niet. De kennisorganisatie van experts onderling, daarentegen, overlapte zeer sterk (d.w.z., sterke ontologie) en was gestructureerd aan de hand van verschillende rechtsgebieden. Overeenkomstig onze verwachting baseerden experts hun structurering bij de kaartsorteertaak vaker op centrale concepten dan novieten en gevorderde studenten. Ook waren experts meer accuraat dan novieten en gevorderde studenten in hun uitleg van concepten tijdens de conceptuitlegtaak.

In hoofdstuk 3 wordt een studie beschreven waarin wederom 24 eerstejaarsstudenten (novieten), 24 derdejaarsstudenten (gevorderden) en 12 docenten (experts) gespecialiseerd in het privaatrecht, deelnamen. In deze studie werd de rol van conceptuele kennis bij het oplossen van casus nader onderzocht. Allereerst werd de rol van conceptuele kennis onderzocht in een situatie waarbij geen externe informatiebronnen mochten worden geraadpleegd tijdens het redeneren. Er werd voorspeld dat: 1) studenten -novieten en gevorderden- in deze situatie minder accuraat zullen zijn in het oplossen van een casus dan experts, en 2) er verschillen zullen zijn tussen studenten en experts wat betreft het probleemoplossingproces omdat studenten minder conceptuele kennis hebben dan experts. Aan deze situatie namen de helft van de eerstejaarsstudenten, de helft van de derdejaarsstudenten en alle docenten, deel. Deelnemers werden geïnstrueerd hardop denkend een casus op te lossen zonder dat zij gebruik mochten maken van een externe bron waarvan zij normaliter wel gebruik zouden mogen maken (in dit geval het burgerlijk wetboek). Onder deze omstandigheden was zoals verwacht de prestatie van eerstejaarsstudenten en derdejaarsstudenten significant lager dan de prestatie van experts. Echter, de prestatie van experts was ook opvallend laag. Deze bevindingen suggereren dat experts niet alleen afhankelijk zijn van het burgerlijk wetboek wanneer zij conclusies onderbouwen, maar ook voor hun gehele argumentatie voorafgaand aan de conclusie. In

tegenstelling tot onze verwachtingen werden er geen verschillen gevonden in probleemoplossingprocessen tussen experts enerzijds en novieten en gevorderden anderzijds. Dat experts en studenten niet verschillen ten aanzien van probleemoplossingprocessen kan een consequentie zijn van het feit dat zij geen gebruik mochten maken van externe bronnen, hierdoor is hun gebruikelijke probleemaanpak mogelijk verstoord. Ten tweede werd middels deze studie onderzocht of eerstejaarsstudenten en derdejaarsstudenten daadwerkelijk kunnen profiteren van de mogelijkheid gebruik te mogen maken van het burgerlijk wetboek tijdens het oplossen van een casus. De veronderstelling was dat alleen de novieten geen voordeel zouden hebben van het mogen gebruiken van het wetboek omdat hun conceptuele kennis ontoereikend is en dit waarschijnlijk ook van invloed is op het gebruik van het wetboek. Om dit te onderzoeken werden de prestaties van 12 eerstejaarsstudenten en 12 derdejaarsstudenten die *wel* gebruik mochten maken van het burgerlijk wetboek tijdens het oplossen van een casus -terwijl zij wederom hardop dachten- vergeleken met de prestaties van de bovengenoemde 12 eerstejaars en 12 derdejaarsstudenten die *geen* gebruik mochten maken van het wetboek tijdens het oplossen van de casus. Zoals verwacht, werd gevonden dat de beschikbaarheid van een wetboek geen effect had op de prestatie van eerstejaarsstudenten, terwijl derdejaarsstudenten juist beter presteerden wanneer zij het wetboek tot hun beschikking hadden. De bevinding dat novieten geen profijt hadden van de mogelijkheid het wetboek te gebruiken is hoogst waarschijnlijk een consequentie van hun gebrek aan conceptuele kennis, hun gebrek aan kennis over de manier waarop de inhoud van het wetboek is gestructureerd, of beide.

In hoofdstuk 4 worden twee experimenten beschreven waarin het effect van twee verschillende vormen van veronderstelde ondersteuning voor het leren redeneren over casus werden onderzocht. Aan het eerste experiment namen 79 eerstejaarsstudenten (novieten) deel en werd het effect van twee vormen van ondersteuning onderzocht middels een 2 bij 2 factorieel design: a) ondersteuning voor hun gebrek aan conceptuele kennis door de *betekenis van belangrijke concepten* uit de casus naast de casus te presenteren, wat hen mogelijk in staat stelt de casusinformatie beter te begrijpen, en, b) het reduceren van hun zoekproces in een externe bron door hen in plaats van het gehele burgerlijk wetboek een *gecondenseerde versie* hiervan te geven die alleen de artikelen bevat die noodzakelijk zijn voor het oplossen van de casus. De gecondenseerde versie zou de cognitieve belasting die vermoedelijk wordt veroorzaakt door het zoekproces in het volledige wetboek -en als gevolg daarvan het leren belemmert- kunnen verlagen. Studenten werden willekeurig in één van de vier condities ingedeeld. Zij startten met het invullen van een kennistoets waarin zij de definitie moesten geven van 20 relevante concepten. Vervolgens bestudeerden zij twee leercasus al dan niet met behulp van extra ondersteuning afhankelijk van de conditie waarin zij ingedeeld waren. Daarna losten zij een testcasus op waarbij geen ondersteuning meer werd geboden. Hierbij mocht iedereen echter gebruik maken van het volledige wetboek. Tot slot vulden studenten de kennistoets nogmaals in. De resultaten lieten zien dat de prestatie op een testcasus significant verbeterde wanneer studenten waren ondersteund met de ge-

condenseerde versie van het wetboek, maar niet wanneer studenten conceptuitleg kregen aangeboden. Deze bevinding suggereert dat de ineffectieve belasting veroorzaakt door het zoekproces in het volledige wetboek de meest voor de hand liggende verklaring is voor de moeilijkheden die novieten ervaren wanneer zij leren redeneren over casus. Ondanks het feit dat het geen effect op redeneren had, bleek het aanbieden van conceptuitleg naast de casus zinvol: in vergelijking tot studenten die geen conceptuitleg ter ondersteuning hebben gekregen, waren studenten die dat wél kregen beter in staat om na de leerfase de formele betekenis van concepten te reproduceren. Waarschijnlijk is het aanbieden van conceptuitleg niet voldoende om het redeneren te bevorderen, omdat de betekenis van de concepten werd gegeven zonder aanvullende informatie over de relaties met andere concepten en de implicaties in de specifieke context. In alle condities was er echter nog veel ruimte voor verbetering in de prestatie op de testcasus. Het tweede experiment onderzocht vormen van ondersteuning voor het gehele redeneerproces.

Aan dit experiment namen 75 eerstejaarsstudenten en 36 derdejaarsstudenten deel. Hierin werd het effect van twee verschillende vormen van ondersteuning onderzocht binnen de twee expertiseniveaus door middel van een 2 bij 2 bij 2 factorieel design: a) *processtappen* die studenten ondersteunen met een aantal generieke stappen dat het redeneerproces leidt, b) *uitgewerkte voorbeelden* ondersteunen studenten met een uitgewerkte modeloplossing van een casus die ze moeten bestuderen. Binnen ieder expertiseniveau werden studenten willekeurig ingedeeld in één van de vier condities. Na het invullen van de kennistoets bestudeerden studenten twee leercasus al dan niet met ondersteuning afhankelijk van hun conditie en losten, tot slot, de testcasus op zonder hierbij ondersteuning te ontvangen waarbij iedereen echter gebruik mocht maken van het volledige wetboek (alles overeenkomstig experiment 1). Voorspeld werd: a) novieten het meeste leren wanneer zij ondersteund worden door uitgewerkte voorbeelden (ongeacht of daarbij processtappen expliciet werden aangegeven), omdat zij niet de nodige kennis hebben om casus op te kunnen lossen, terwijl, b1) gevorderde studenten, net als novieten, voordeel zouden kunnen hebben van het bestuderen van uitgewerkte voorbeelden, of, b2) -indien er ook een 'expertise reversal effect' optreedt (dat vaak gevonden wordt in minder complexe domeinen; Kalyuga, Ayres, Chandler, & Sweller, 2003) in complexere domeinen zoals het rechtsdomein- gevorderde studenten voordeel zouden hebben van processtappen die meer generieke sturing bieden. De resultaten op de test lieten zien dat de prestatie significant verbetert nadat zowel eerstejaars als derdejaarsstudenten uitgewerkte voorbeelden hebben bestudeerd. Wanneer studenten werden ondersteund met processtappen werd leren niet bevorderd. Integendeel, het had een ongunstig effect op de prestatie voor beide groepen studenten wanneer alleen de stappen werden gegeven, d.w.z., niet in combinatie met een uitgewerkt voorbeeld. Een mogelijke verklaring is dat processtappen interfereren met het leren, omdat studenten de stappen proberen toe te passen, maar niet in staat zijn dat effectief te doen, omdat zij zelf moeten achterhalen welke informatie relevant is voor de stappen en hoe de stappen toegepast dienen te worden.

In het addendum bij Hoofdstuk 4 wordt tenslotte een veldstudie beschreven naar de implementatie van uitgewerkte voorbeelden bij een rechtenfaculteit in een vier weken durend onderwijsblok over eigendomsrecht voor eerstejaarsstudenten. Studenten moesten iedere week voor het begin van het werkcollege een uitgewerkt voorbeeld van een situatie met betrekking tot eigendomsrecht bestuderen. Tijdens het werkcollege bediscussieerde de docent het bestudeerde voorbeeld met de studenten. De tentamenresultaten waren positief (d.w.z., meer studenten slaagden) ten opzichte van de tentamenresultaten van het voorafgaande jaar waarin studenten niet middels uitgewerkte voorbeelden hadden geoefend. Deze bevindingen dienen natuurlijk voorzichtig geïnterpreteerd te worden. Op basis van de beschikbare data kan immers niet worden uitgesloten dat dit cohort studenten niet op andere aspecten verschilt van dat van het voorgaande jaar. Het lijkt er echter op dat het bestuderen van uitgewerkte voorbeelden niet alleen in een experimentele setting, maar ook wanneer het wordt toegepast in een juridisch curriculum, het leren bevordert.

Tot slot worden in Hoofdstuk 5 de belangrijkste bevindingen bediscussieerd in termen van theoretische en praktische implicaties, gevolgd door suggesties voor toekomstig onderzoek.

Curriculum Vitae

Fleurie Nievelstein werd geboren op 30 januari 1982 te Landgraaf. In 2000 slaagde zij voor haar atheneum examen op College Rolduc te Kerkrade. Van 2000 tot en met 2004 studeerde zij cognitieve psychologie, met als afstudeerrichting onderwijspsychologie, aan de Universiteit Maastricht. Vanaf 2004 tot en met 2009 werkte Fleurie als promovenda bij het Centre for Learning Sciences and Technologies aan de Open Universiteit Nerderland in Heerlen. Gedurende haar promotieproject was zij als docent verbonden aan de Masteropleiding Onderwijswetenschappen. In 2009 kende de American Educational Reasearch Association (AERA) de prijs voor de beste paper van een nieuwe onderzoeker toe aan Fleurie Nievelstein.

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